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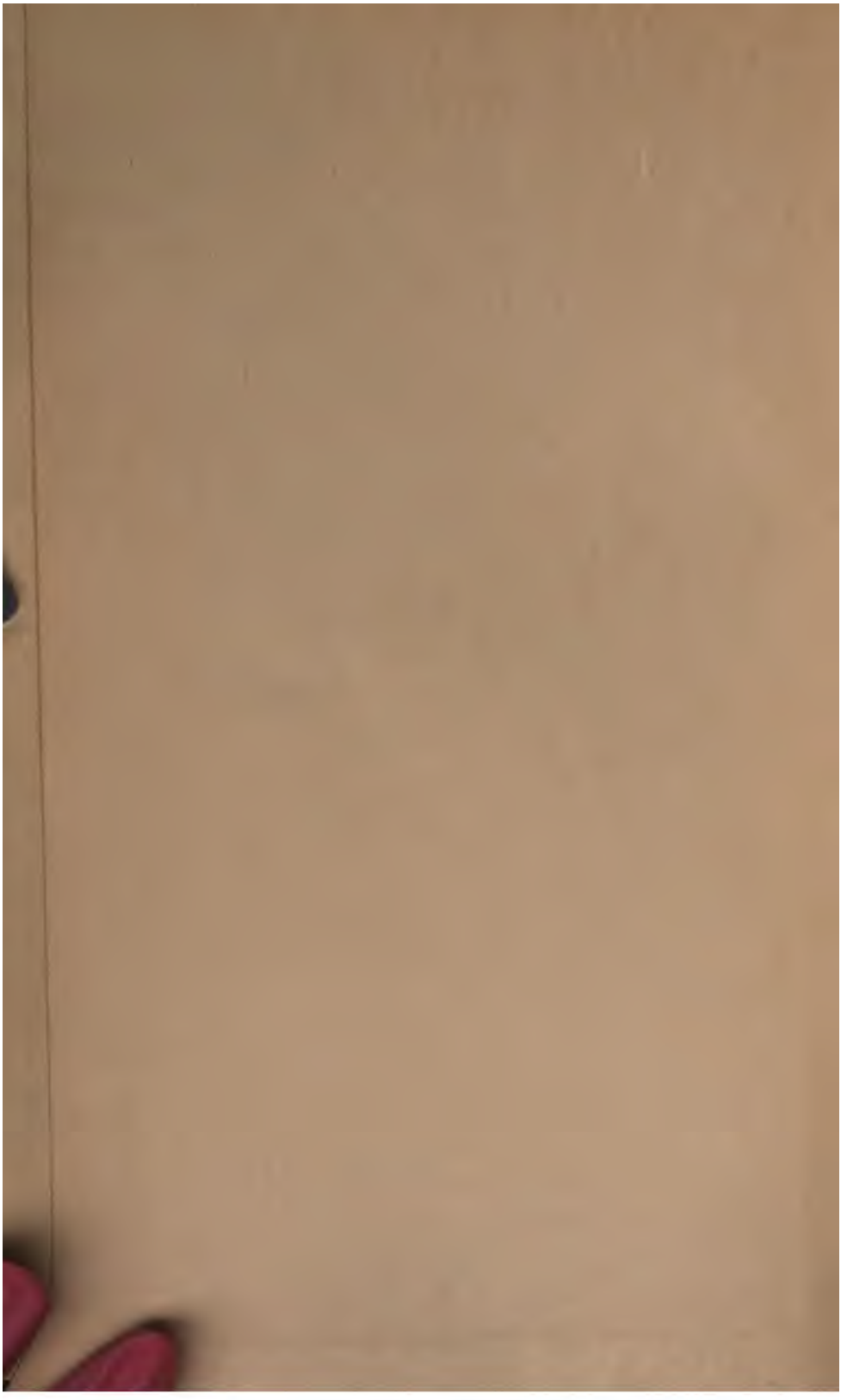

CALIFORNIA FISH AND GAME

"CONSERVATION OF WILD LIFE THROUGH EDUCATION"

Volume 7 Sacramento, January, 1921 Number 1

SALMON NUMBER

CALIFORNIA FISH AND GAME

"CONSERVATION OF WILD LIFE THROUGH EDUCATION"

Volume 7 Sacramento, January, 1921 Number 1

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THREE CALIFORNIA MARKED SALMON RECOVERED.

By J. O. SNYDER, Stanford University.

Three marked king salmon were secured last summer by W. L. Scofield, who was engaged in making obeservations for the Fish and Game Commission. Each of the three specimens had the adipose and left ventral fins excised. The mutilations were of such a nature that they could not be attributed to any other causes than the methods used in marking small fish. One was taken at Monterey, April 6. It measured 73 centimeters. Along with others it was eviscerated before anything unusual was noticed regarding the fins. The sex, therefore, could not be determined with certainty. The second was caught at Shelter Cove

early interrupted in the case of the Monterey fish, while allowed to progress farther in the Shelter Cove and Pittsburg examples.

The most valuable information coming to us with the capture of these marked fish is that the sea range of Sacramento salmon not only embraces Monterey Bay to the southward, but that it extends far northward as well. Now there is urgently desired at the present time some definite information regarding the source of supply of the marine salmon fisheries, and we have here a very plain suggestion as to the procedure necessary to gain at least some of that information. To be sure, it is perfectly well known that these salmon breed in certain large streams, but it is not known whether California streams alone contribute to our ocean supply, or whether we are in a measure reaping a harvest from seed sown north of our boundaries. The opinion has been freely expressed in some quarters that the salmon of Monterey Bay are from the Sacramento River, that those from Fort Bragg and Shelter Cove are from streams entering the ocean north of these localities, and in short, that young salmon on migrating into the ocean progress southward from their place of entry, where they live and grow until the approach of maturity. With a firm belief in the theory of southward migration, some fishermen and others of experience will even pretend to identify Columbia River salmon among those caught near Fort Bragg. We have at present very little to show that their belief is not well founded, but they have still less to demonstrate that it is. The capture of this marked Sacramento River fish at Shelter Cove, a long distance north of the mouth of the river, is then easily seen to be a matter of considerable importance. The evidence derived from a single example should not be overestimated, however, and it seems evident that only investigation involving carefully planned experiments will be of definite aid here and elsewhere in a profitable study of the life history of the salmon. It is very probable that such investigation might be carried on to better advantage in a stream much smaller than the Sacramento, for when one comes to consider the difficulties of obtaining results from a marking experiment, for example, in a very large river with the wide distribution and varied character of its fisheries, it is really remarkable that even three fish from a considerable number were secured. Moreover, the question as to whether some of our smaller streams may be made to contribute with profit to sea fishing is well worth considering, for the present rapid growth of irrigation and power projects, which seriously interfere with the natural breeding grounds of salmon in the Sacramento and Klamath rivers, foreshadows the time when some attention will be directed elsewhere if we seriously care to maintain our supply of these fish.

There is one point of interest connected with these scales to which, however, one is not as yet warranted in attaching any real significance. It will be observed that in the Shelter Cove scale, and particularly in that from the Sacramento River, the annual checks are very marked, while in the Monterey specimen they are much less distinct. A comparison of a large number of scales from the region of Fort Bragg and Shelter Cove, with many from Monterey Bay, seems to give the impression that the presence of sharply defined annual checks is not very characteristic of scales of Monterey salmon, but that, in contrast

with those from the region of Fort Bragg, they are much less pronounced and in many cases difficult to detect. Although one is not prepared to even speculate as to the reason for this, especially since the cause of the growth check is not known, it is, at any rate, of passing interest to observe that in the character of the growth check both the Monterey and Shelter Cove scales conform to what appears to be the fashion in each locality. And if appearances are not misleading, one would be tempted to suspect that the Sacramento fish

FIG. 3. Photomicrograph of scale of salmon marked at the Mount Shasta Hatchery in 1917 and taken in the Sacramento River at Pittsburg, September 15, 1920. Sex, male; length 68 centimeters. Numerals mark the end of the first, second and third years of growth.

had spent its sea life in the region of Fort Bragg or Shelter Cove. Furthermore, if we calculate the length attained by each fish at the end of the second and third years, which may be done with some degree of accuracy from measurements obtained from the scales, it will be seen that the Shelter Cove and Pittsburg specimens agree in being smaller than the one from Monterey.

Monterey ---------- second year 30 centimeters; third year 71 centimeters
Pittsburg ---------- second year 27 centimeters; third year 55 centimeters
Shelter Cove ------ second year 22 centimeters; third year 50 centimeters

This may be only a matter of coincidence, but interest will not be lost after a comparison of a number of fish from Fort Bragg and Monterey. From the scales of a hundred fish caught in Monterey Bay, and which had apparently entered the sea as yearlings, the average length at the end of the second and third years was computed. The same was done with a like number of similar fish from the vicinity of Fort Bragg. In both cases the specimens were taken at random as they appeared in the catch. The result was as follows:

Monterey _____second year 38 centimeters; third year 65 centimeters
Fort Bragg _____second year 35 centimeters; third year 59 centimeters

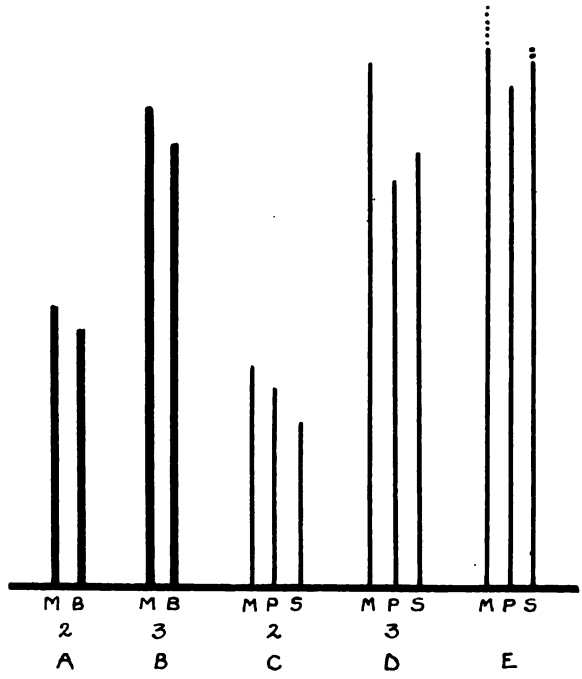

FIG. 4. Diagram showing the average length of marked and unmarked salmon, at two and three years of age, taken at various places.

A simple diagram will serve well to show these comparisons. A and B represent the average lengths at 2 and 3 years, M being the fish from Monterey, and B representing those from Fort Bragg, including Shelter Cove. C and D are the lengths of the marked fish from Monterey, Pittsburg and Shelter Cove at the end of second and third years. E represents the lengths of these fish at time of capture, the dotted tips indicating that growth was interrupted by capture before maturity.

Judging from the experience of investigators who have experimented with the marking of salmon, we may expect to see more of these fish in the fifth year. Their capture will be awaited with interest.

AN INSTANCE OF ADULT, SEA-RUN CHINOOK SALMON FOUND FEEDING IN FRESH WATER.*

By WILLIS H. RICH, Field Assistant, United States Bureau of Fisheries

During the course of the writer's investigation of the salmon of the Columbia River, it was learned, through apparently reliable sources, that the chinook salmon which entered the Cowlitz River during the early spring were feeding upon the smelt or euchalon (*Thaleichthys pacificus*) which run in large numbers at this time of year.

The Cowlitz River empties into the Columbia River nearly seventy miles above the mouth of the latter — well above the highest reach of brackish water. It is well known that the habit of adult salmon, entering streams for the purpose of spawning, is to cease feeding at least as soon as the fresh water is entered. In many cases the fish apparently cease to feed as soon as they leave the open ocean and definitely begin the journey to the spawning grounds even though the first part of the journey may be through pure, or nearly pure sea water. This is true of the Fraser River sock-eyes which enter Puget Sound through the Strait of Juan de Fuca and which cease to feed as soon as the journey through the strait has begun.† The mature salmon taken just within the mouth of the Columbia River have ceased feeding although the water is only slightly fresher than sea water. Numerous other examples illustrating the same point might be cited. In view of these facts, the feeding of salmon so far from the ocean as the Cowlitz River formed a remarkable contradiction to the usual habit and it seemed desirable to fully investigate the report. On account of the spring closed season no commercial fishing for salmon was being carried on at the time the smelt were the most plentiful and it was necessary to make special efforts to secure specimens. On April 14, 1916, in company with a fisherman and one of the state fish wardens, several drifts with a gill net were made in the Cowlitz River

FIG. 5. Stomach of an adult sea-run Chinook salmon found feeding in the Cowlitz River, Washington. As a rule the stomach of a salmon found in fresh water shows no evidences of its being in use.

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†This is described by Gilbert in his paper on The Salmon of Swiftsure Bank, Report of the Commissioner of Fisheries, Province of British Columbia, 1912 (1913), page 116.

just below the town of Kelso. One chinook was finally secured—a female weighing about 25 pounds. The examination fully confirmed the reports, as the stomach contained upward of a dozen smelt in various stages of digestion. The stomach, partially dissected in order to expose the contents, is shown on the previous page.

This unusual habit is without doubt occasioned by and associated with the presence of enormous numbers of smelt. These smelt enter the Cowlitz and a few other tributaries of the Columbia River for the purpose of spawning and, at the height of the season, are gathered in close schools in small restricted localities. The laying of the eggs is apparently accomplished while they are thus aggregated. Evidently these conditions as found in the Cowlitz, where large numbers of small fish are closely schooled, approximate the normal feeding conditions as found in the ocean. Similar habits of the salmon will doubtless be found in other streams which have runs of smelt or other small anadromous fishes coinciding with a run of chinook salmon. Other species of salmon may also have a similar habit. It is probable that the salmon have followed the smelt run in from the ocean and that they continued to feed while passing up the main river and into the Cowlitz. This seems more likely than the alternative, that they had ceased feeding on leaving the ocean but began again on entering the Cowlitz.

In this connection it should be noted that the precocious male salmon which have matured after spending the first year in fresh water continue to feed even after the sex products have ripened. Such precociously mature males are commonly found both among wild fish and among those which have been reared in hatchery ponds. In certain instances it has been noted that these mature yearlings have recovered from the effects of maturity and have survived—contrary to the rule in the case of sea-run adults.*

It would seem that this is chiefly on account of the fact that the normal food supply has been constantly present so that it has not been necessary for the fish to cease feeding during the spawning period. The fact that adult, sea-run salmon will frequently take the hook when well into fresh water is further evidence that the normal feeding reaction is not disturbed merely by the entrance into fresh water. At many places chinook salmon may be taken by trolling with large spoon hooks. The salmon fishing at the Oregon City Falls on the Willamette River is well known. The steelhead fishing on other western streams, particularly the Rogue River, has a wide spread reputation, as has also the fishing for Atlantic salmon in Maine and Canada. In many cases these fish are taken hundreds of miles above the mouth of the streams.

It may be concluded from these observations that one of the factors which cause salmon on entering a stream for the purpose of spawning to cease feeding is the lack of a normal food supply. In the particular instance herein described, a normal food supply was present, with the result that the fish fed in a normal manner. It is possible that a longer residence in fresh water or the nearer approach of the spawning season would cause the fish to cease feeding even though a normal food supply was available.

* *Early History* and Seaward Migration of Chinook Salmon in the Columbia and *Sacramento Rivers.* By Willis H. Rich. Bulletin of the Bureau of Fisheries, *XXXVII, 1919–20. Doc. 887, page 67.*

STEELHEADS CAUGHT AT SEA OFF THE COAST NEAR FORT BRAGG.

By J. O. Snyder, Stanford University.

Trollers fishing for salmon off the coast north of San Francisco have reported the capture of steelhead trout at sea. None of these trout has been available for study until this summer, when W. L. Scofield, while making observations for the Fish and Game Commission at Noyo River near Fort Bragg, was fortunate enough to separate 16 specimens from the mass of king and silver salmon brought in there. Material was preserved so that no doubt is involved in the identification of these fishes. From the collector's notes the following paragraph is taken:

The first steelheads appeared July 23, and the last one was seen August 25. On August 14 five specimens were found, and again on

Fig. 6. Noyo Estuary, showing salmon fishing boats. Photograph by J. O. Snyder, 1920.

August 16 the same number were secured. In color they were of the characteristic steel blue above and bright silvery on the sides; the dark upper surface with small blackish spots, numerous on some examples, less abundant on others; the head with few or no spots. The dorsal, adipose and caudal fins were spotted, the size and number of spots varying considerably in different individuals. The pectoral and ventral fins were immaculate except for dark anterior margins. the lateral series of scales as recorded from twelve individuals number from 132 to 143, the count being made to base of caudal fin; the series from lateral line to back 25 to 34. They measured 19 to 29 inches, and weighed 2¾ to 9¾ pounds. There were eleven males.

These fishes are regarded as examples of *Salmo irideus*, the rainbow trout. This identification is based on what appears to the writer as a well-founded assumption, that but two species of trout* inhabit

* Bureau of Fisheries Document No. 638, page 183.

the costal region of California, *S. irideus* and *Salmo clarkii*, the cutthroat trout, sea living individuals of both being known as steelheads.

The steelheads enter the rivers to spawn, their progeny in turn migrating to sea where food is plentiful, or remaining for an indefinite time in fresh water as the case may be, the latter being recognized as stream trout. The rainbow trout is a large scaled form, there being about 110 to 150 series of scales on the body, while the cutthroat has smaller scales, about 150 to 200 series. In their distribution the two species overlap, both occurring in the coastal streams from Redwood Creek northward.

In spite of the fact that these steelhead trout have been known for many years and that they are of considerable economic importance, our store of carefully observed and recorded facts concerning them is very meager. Some observations have lately been made on the Klamath, in which river both species enter from the sea and migrate for

Fig. 7. Noyo Estuary, showing canneries. Photograph by J. O. Snyder, 1920.

spawning purposes. Here there are two fairly distinct migrations of steelheads, one occurring in the winter, the other in the summer. Of the winter run we know very little; nothing, in fact, of what species it is composed. The summer run consists almost entirely of *S. irideus*, an example of *S. clarkii* occasionally appearing. The latter may be spoken of as one among thousands in the migration of the former. In the summer of 1919* the first steelheads were taken in salmon nets on July 11; the largest number were caught about August 27, and the run had about ceased October 22. The progress of the steelhead migration coincided in general with that of the king salmon, not only in its rise and decline, but in its periodical irregu-

* Agents of the Fish and Game Commission have been making observations on the trout and salmon for two summers in the estuary of Klamath River. Through the kindly interest of Mr. G. R. Field, they have been enabled to examine thousands of individuals, which his fishermen have taken.

larities as well, a large wave of steelheads being generally associated with a similarly large wave of salmon.

As these steelheads appear fresh from the ocean, many still bearing living salt water crustacea attached to their bodies, they are of a beautiful deep steel blue above, with highly burnished silvery sides. They have usually very definite black spots on the head and body, they are always present on the dorsal, adipose and caudal fins, while the remaining fins are immaculate. Sometimes the head is without spots and the body has very few. Counts on a number of examples resulted as follows: Head spots, 0 to 25; body, 8 to 271; dorsal fin, 47 to 98; adipose, 1 to 9; caudal, 14 to 220. The spots of the head are almost always round; those of the body elongate or linear. The ova found in these fishes are very small, their undeveloped condition giving rise to the suggestion that the steelheads have entered upon a very long migration or at least a considerable period in fresh water. Their stomachs are mostly empty, and they remain so at least while they are in the estuary for the very simple reason that there is not food enough in the river to supply such a horde, were its members inclined to eat. They occasionally strike a spinner, but they will not rise to fly, nor are they often attracted to a baited hook. Later in the season and farther up stream their appetites are said to return, and their behavior is governed accordingly. About the middle of August, steelheads that have begun to assume their nuptial colors are occasionally seen in the estuary. The cheeks become tinted with pink, and a broad reddish blush appears along the sides. At the same time the dark dorsal area loses its marine hue and becomes light olive. No salt water crustacea are found attached to these tinted individuals, and it appears probable that they have been in fresh water for some time. The steelheads fresh from the sea are plump, fat and full of energy. At times they have been seen in numbers leaping high from the water and falling with a resounding splash, in strong contrast to the salmon which only cut the surface with their backs and tails.

The largest steelhead caught in the Klamath is said to have weighed 32 pounds. Those which appear from day to day are much smaller. For example, on August 13 and 14 of this year, 248 specimens that were caught in gill nets measured 14½ to 32 inches and weighed 1¼ to 14⅜ pounds. The entire lot gave an average weight of 5.86 pounds; 10,862 examples showed an average weight of 4.3 pounds. Small fishes are not apt to become entangled in the coarse meshes of the drifting gill nets, and it is therefore of interest to find that a fine meshed seine will bring from the river not only large specimens but smaller ones as well, individuals 8 or 10 inches in length having been taken which exhibit every detail of color possessed by the larger steelhead fresh from the sea. Whether these small fishes have just come in from the ocean we are unable at present to say.

The scales of these Klamath steelheads which are identified as *Salmo irideus*, rainbow trout, number 116 to 150 in the lateral series. The steelhead trout taken at sea near Fort Bragg are of the same species as those that enter the Klamath in the summer in such large numbers. They may even be Klamath trout for all that we know, but it seems more reasonable to assume that their parent stream is somewhere nearer their place of capture.

THE RELATIVE MATURITY OF THE CHINOOK SALMON TAKEN IN THE OCEAN ALONG THE PACIFIC COAST.*

By WILLIS H. RICH, Field Assistant United States Bureau of Fisheries.

This paper is in the nature of a preliminary report dealing with the maturity of the chinook salmon taken by troll and purse-seine in the ocean along the Pacific coast, and is presented for the purpose of making immediately available some of the results of the investigation. It is also believed that the method used for determining the relative maturity is new and may be of value to others engaged in similar investigations. A later report will give in detail the data upon which the conclusions presented in this paper are based, and will discuss several topics treated very briefly, or omitted entirely from this paper.

The amount of trolling and purse-seining for chinook salmon along the Pacific coast has increased enormously during the past few years, especially along the northern coast of California, the coast of Oregon, and off the mouth of the Columbia River. To anyone who has observed even casually the fish thus taken in the ocean it is perfectly apparent that a great proportion are immature and it is a point of considerable interest and practical importance to know just what percentage are immature and the relative degree of immaturity. The determination of the age by means of scale studies will not, alone, give a sufficient index to the degree of immaturity since there is such a wide range in the age at which these fish reach the spawning stage—from two to six years. If the percentages of individuals of different ages among the mature fish were constant, it would be possible, from a determination of the percentages of fish of different ages taken by troll and purse-seine in the ocean, to estimate the percentage of fish of different degrees of maturity. This, however, is not the case. The percentages of fish of the various age-groups vary greatly at different times among the mature fish and also among those taken in the ocean. Presumably these variations are due quite largely to racial differences but our present knowledge of the various races of chinook salmon is quite too limited to aid in segregating the races from mixed lots. Even if our knowledge of the races were complete it might well be that they could not be identified and segregated accurately and fully enough to serve the purpose. It is apparent that some other means than the determination of the age is necessary in order to learn the percentages of mature and immature fish taken in the ocean and their relative maturity.

The method which has been developed for determining the relative maturity is based upon variations in the size of the eggs. Obviously this can be applied only to the females and no method has yet been devised for determining the relative maturity of the males. The percentages of males and females found among the mature fish of the various age groups will give some basis for estimating the percentages of mature and immature males from the determination of the relative maturity of the females, but a discussion of this topic must be reserved

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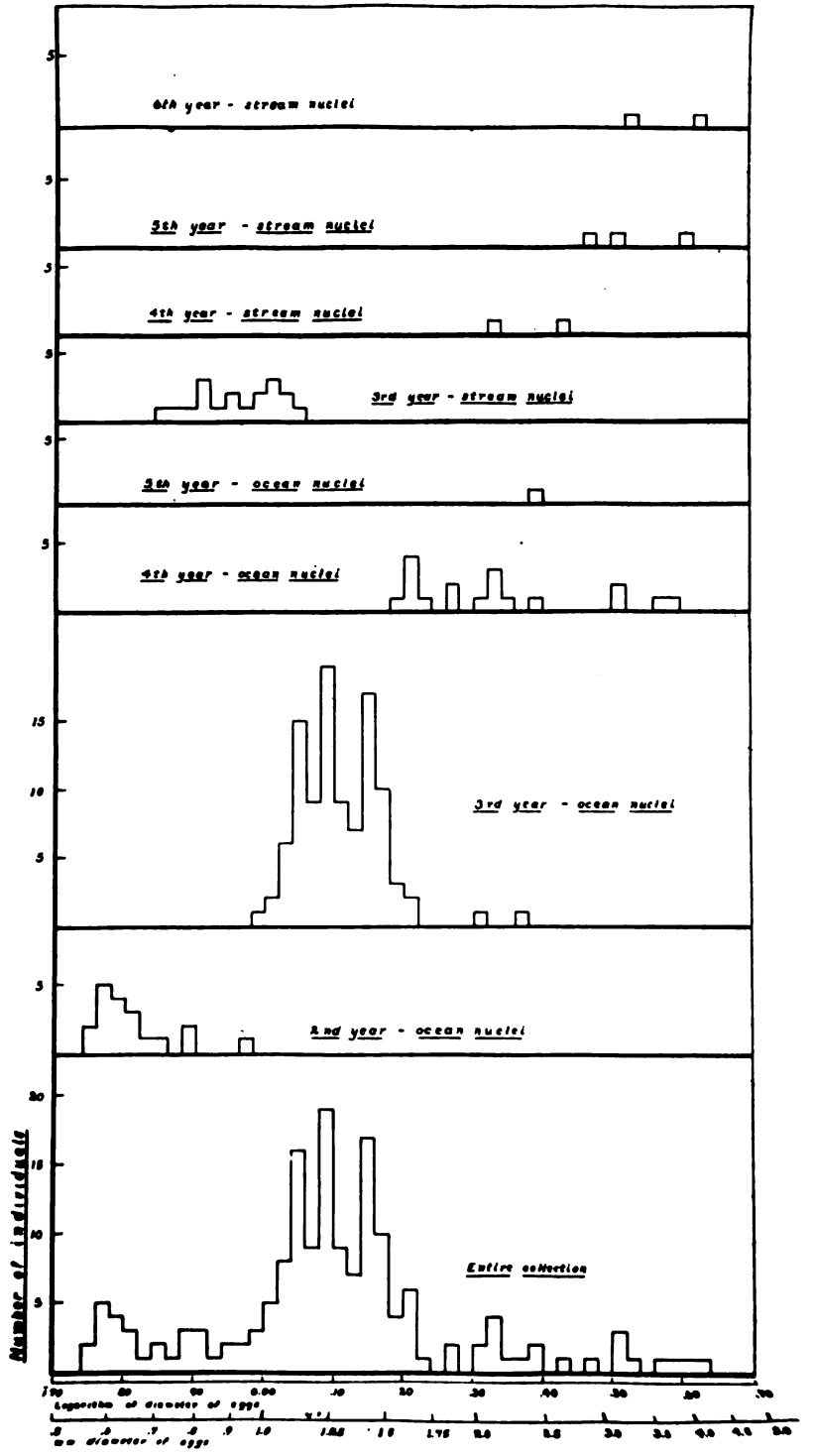
6th year - stream nuclei
5th year - stream nuclei
4th year - stream nuclei
3rd year - stream nuclei
5th year - ocean nuclei
4th year - ocean nuclei
3rd year - ocean nuclei
2nd year - ocean nuclei
Entire collection
Number of individuals

FIG. 8. Histogram showing frequency-distribution of 163 female salmon [illegible] by troll off the mouth of the Columbia River, May 8, 1919, based on logarithms of the diameters of the eggs.

for the complete report. It is sufficient to state here that, while there is a tendency for the males to mature somewhat younger than the females, the error which would result from assuming that the proportions of fish of similar degrees of maturity were equal in the males and females would not be serious.

Superficial examination of the eggs found in the females taken in the ocean shows that there is a wide diversity in the size and, further, that several more or less distinct size-groups are distinguishable even without careful measurement. It is a natural assumption that these various sizes of the eggs indicate different degrees of maturity. A careful study of several collections of fish taken within the Columbia River and by troll off the mouth of the Columbia, in Monterey Bay, California, and along the northern coast of California confirms this assumption and shows that, by means of a study of the variation in the size of the eggs and a determination of the age by means of the scales it is possible to distinguish, with certainty, in many cases, and with reasonable probability in most, between fish which would have spawned during the year in which they were taken and those which would not have spawned for at least one more year. The distinction between fish which would not have spawned for two years is not quite as definite but in some collections the interpretation is clear.

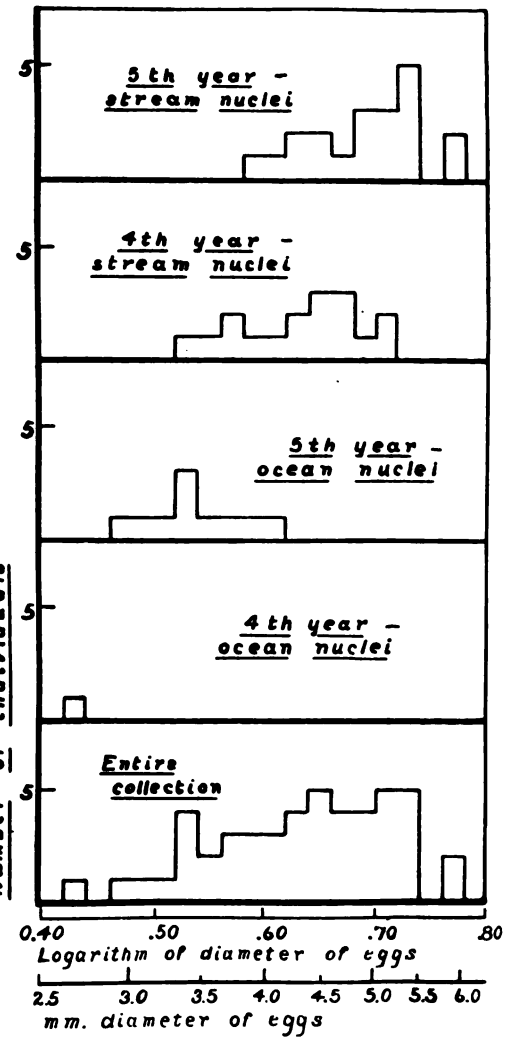

FIG. 9. Histogram showing frequency-distribution of 48 females taken by beach seines and wheels near Warrendale, Oregon, June 16, 1919, based on the logarithms of the diameters of the eggs.

In studying these collections the age has been determined by the usual method of scale study. The size of the eggs has been determined by measuring ten of each sample and taking the average. The larger eggs—those over 1 mm. in diameter—were measured in a simple device

which consists essentially of a small trough, V-shaped in cross-section and with closed ends, which is graduated in millimeters. In use this is partially filled with water, the eggs are placed in a row in the bottom

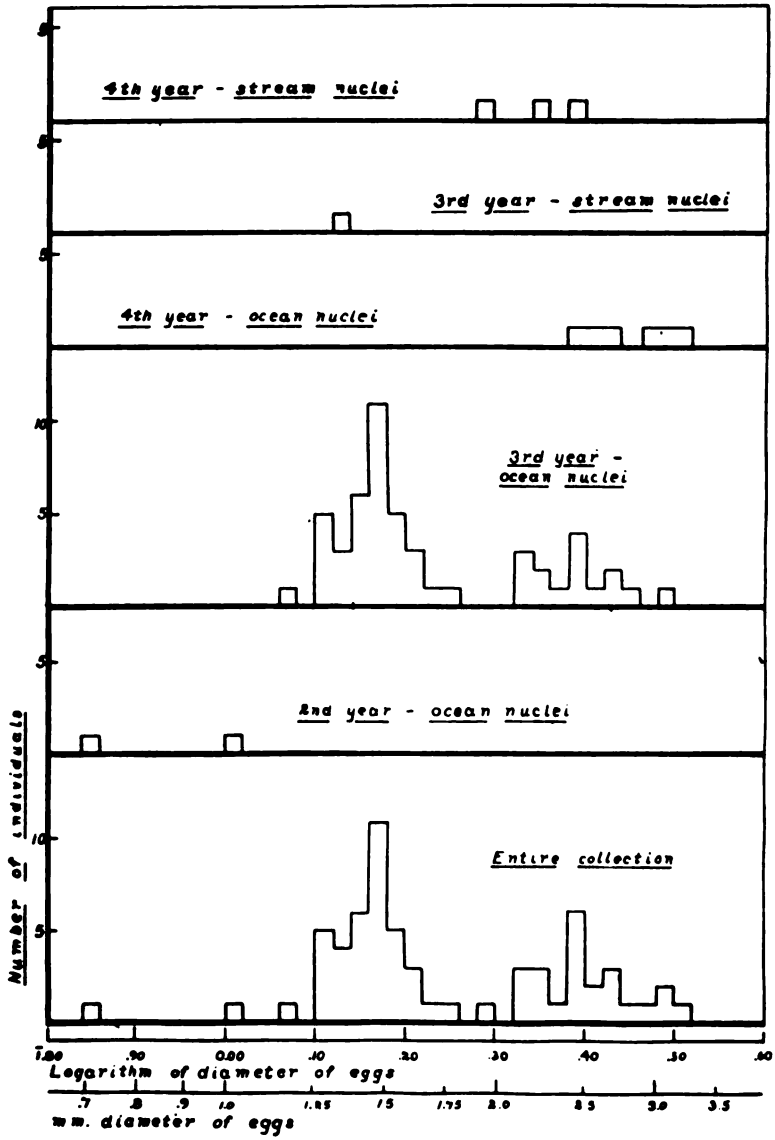
4th year - stream nuclei
3rd year - stream nuclei
4th year - ocean nuclei
3rd year - ocean nuclei
2nd year - ocean nuclei
Entire collection
Number of individuals
Logarithm of diameter of eggs
mm. diameter of eggs

FIG. 10. Histogram showing frequency-distribution of 63 females taken by troll in Monterey Bay, California, June 19–21, 1918, based on the logarithms of the diameters of the eggs.

of the trough, and then are carefully pushed up to the zero end of the scale by means of a small piece which fits the bottom of the trough and on which is graduated a vernier enabling one to read accurately to tenths of a millimeter. The measurement of ten eggs by this scale

gives directly, by simply moving the decimal point one place to the left, the average size of the eggs to hundredths of a millimeter. As a matter of fact this measurement is finer than is necessary in the great majority of cases. In preparing eggs for this measurement it is necessary to free them very carefully from the ovarian membranes so as not to break the delicate shell and yet to clear them of all shreds of tissue which might tend to affect the measurement. The smaller eggs—those less than 1 mm. in diameter—were measured by means of a microscope fitted with an eyepiece micrometer carefully standardized. In using this method it was necessary, of course, to measure the ten eggs separately and then the average of these measurements was found.

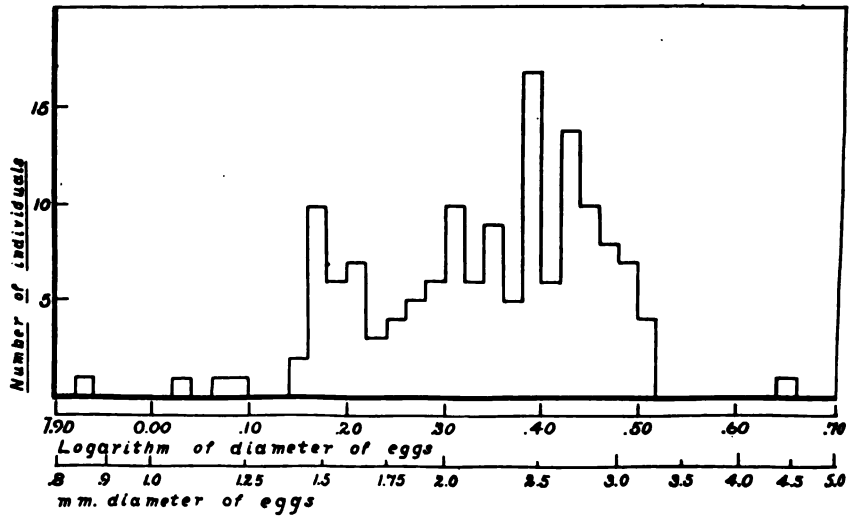

FIG. 11. Histogram showing frequency-distribution of 144 females taken by troll in Monterey Bay, June 29, 1915, based on the logarithms of the diameters of the eggs.

The tabulating and plotting of these egg measurements has been done on a logarithmic basis—that is, the logarithms of the actual measurements have been tabulated rather than the measurements themselves. The main advantage of this sort of tabulation lies in the fact that proportional variations in size are equally shown independent of the actual size, and it is the relative size of the eggs, rather than the actual diameter, which is significant.[1]

In preparing the tables and charts the classes have been arranged with intervals of .02 in the logarithm of the diameter of the eggs. This signifies that the mid-value of each class is 4.713 per cent greater than that of the class next preceding.

The following collections have been used in the preparation of this preliminary report:

1. 163 females taken by troll off the mouth of the Columbia River, May 8, 1919.
2. 68 females taken by troll off the mouth of the Columbia River, June 4, 1919.
3. 48 females taken by beach seines in the Columbia River near Warrendale, Oregon, June 16, 1919. (Warrendale is approximately 150 miles above the mouth of the river.)

[1] The writer is indebted to Prof. F. W. Weymouth of Stanford University for an acquaintance with this method of tabulating.

4. 48 females taken by traps in Baker Bay, Columbia River, July 3, 1919. (Baker Bay and Sand Island, where the next collection was taken, are both just within the mouth of the river.)

5. 41 females taken by beach seines on Sand Island, Columbia River, July 6, 1919.

6. 101 females taken by troll off the mouth of the Columbia River during August 13 to 17 and September 16 to 17, 1918. (But five of these were taken in September and these have been considered with the August collections.)

7. 95 females taken by troll off the mouth of the Columbia River, August 13, 1919.

8. 63 females taken by troll in Monterey Bay, California, June 19 to 21, 1918.

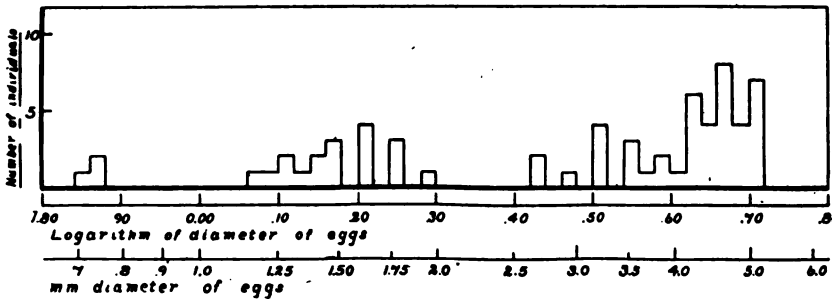

FIG. 12. Histogram showing frequency-distribution of 64 females taken by troll near Drake's Bay and Fort Bragg, California, July and August, 1918, based on the logarithms of the diameters of the eggs.

Full data including scales were taken with each of the above collections. In addition to these the following two collections consisting of eggs alone were studied:

9. Eggs from 144 females taken by troll in Monterey Bay, June 29, 1915.

10. Eggs from 64 females taken by troll near Drake's Bay, August 15 and 16, 1918, and Fort Bragg, July 17, 1918, on the coast of northern California. Scales and data were also collected from the females at the same time the collections of egg samples were made, but the records were not kept so that the egg samples could be referred to the corresponding data and scales. It has been necessary, therefore, to treat egg samples and other data independently.

It will be impossible, in this report, to give in detail the evidence necessary to prove the validity of this method for determining the relative maturity. The graphs will, however, give illustrations of typical results obtained from the measurement and tabulation of the eggs. An examination of the graphs shows that, in the collection of undoubtedly mature fish from Warrendale, the eggs were fairly uniform in size, ranging from about 2.5 to 6 mm. in diameter. The obvious graduation in size of the eggs in the different age-groups is probably significant of racial differences, but a discussion of this point cannot be given in this paper. In the case of the fish taken by troll in the ocean the frequency-distribution based on egg sizes shows a distinct grouping around several modes which are usually quite well separated.

Three modes are especially distinct and, in the case of the collections for which age determinations were also made, and which have, therefore, been separated into the component age-groups (Monterey, 1919, and Columbia River, May, 1919) it is apparent that the group characterized by the largest eggs (above 2 mm. in diameter) is composed chiefly of

fish in their third, fourth and fifth years, whose scales show the ocean type of nucleus, and of fish in their fourth and fifth years whose scales show the stream type of nucleus. [The nuclear growth here referred to is that located close to the center of the scales and represents the portion of the scales formed during the first year. The "stream" type indicates that the fish remained in the stream during the entire first year of its life. The "ocean" type of nuclei indicate that the fish have migrated seaward sometime during the first year, usually early.]

The group representing the next smaller size of eggs (1.25 to 1.5 mm.) in diameter is characterized especially by fish in their third year with either ocean or stream nuclei, while the group representing the smallest eggs (.6 to .8 mm.) is characterized chiefly by fish in their second year with ocean nuclei. The size of the eggs in the group having the largest eggs corresponds, in each instance, with the size of eggs in the Warrendale collection and are, therefore, without doubt fish which would have matured during the year in which they were taken.

It is apparent, then, that in general the group characterized by the largest eggs is composed of fish one year older than those composing the group with eggs of the next smaller size, and that these in turn are one year older than those composing the group with the smallest eggs. These differences in the size of the eggs are not dependent on corresponding differences in the size of the fish. There is, indeed, a distinct correlation between the size of the fish and the size of the eggs, but, as will be shown in the more detailed report, this correlation is by no means ample and is unquestionably modified by the approach of maturity. Of particular interest and significance is the presence of two groups of individuals within the same age-group which may be definitely separated on the basis of egg sizes. This is shown with unusual clearness in the third year fish with ocean nuclei taken at Monterey in 1918. The group with eggs greater than 2 mm. would undoubtedly have spawned during the fall of the same year in which they were taken, while the fish composing the other group would not have spawned for at least one more year. These facts which have been so briefly and incompletely discussed seem to fully justify the conclusion that the size of the eggs is a fairly reliable index of the relative degree of maturity of chinook salmon.

Without attempting to discuss further the method used for determining relative maturity, a tabular summary will be given of the results obtained by the study of the ten collections which have formed the basis for this report. It is hoped that further study will increase the accuracy of the results, and it seems probable that some of the percentages given in the table may be somewhat modified by additional investigations. It is believed, however, that the results as given here are fairly reliable. In preparing the table care has been taken to include doubtful cases always with the more mature of the two groups to which they might be assigned. This has been done in order not to exaggerate the degree of immaturity exhibited by any of the various collections.

TABLE I.

Composition as to age groups and relative maturity of a collection of 165 females taken by troll off the mouth of the Columbia River, May 8 to 10, 1919.

Age groups	Number of specimens and per cent which would mature during:						Total	
	Year taken		Following year		Second year following			
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Ocean nuclei—								
In 2d year					19	100	19	11.5
In 3d year	2	2	100	98			102	61.8
In 4th year	18	100					18	10.9
In 5th year	1	100					1	.6
Stream nuclei—								
In 3d year			18	100			18	10.9
In 4th year	2	100					2	1.2
In 5th year	3	100					3	1.8
In 6th year	2	100					2	1.2
Totals	28	17	118	71.5	19	11.5	165	

TABLE II.

Composition as to age groups and relative maturity of a collection of 68 females taken by troll off the mouth of the Columbia River, June 4, 1918.

Age groups	Number of specimens and per cent which would mature during:						Total	
	Year taken		Following year		Second year following			
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Ocean nuclei—								
In 2d year					18	100	18	26.5
In 3d year			32	97	1	3	33	48.5
In 4th year			1	100			1	1.5
In 5th year	1	100					1	1.5
Stream nuclei—								
In 3d year			10	100			10	14.7
In 4th year	2	50	2	50			4	5.8
In 5th year			1	100			1	1.5
Totals	3	4	46	68	19	28	68	

TABLE III.

Composition as to age groups and relative maturity of a collection of 48 females taken by seines and wheels near Warrendale, Oregon, June 16 and 17, 1919.

Age groups	Number of specimens and per cent which would mature during:						Total	
	Year taken		Following year		Second year following			
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Ocean nuclei—								
In 4th year	1	100					1	2
In 5th year	10	100					10	21
Stream nuclei—								
In 4th year	17	100					17	35
In 5th year	20	100					20	42
Totals	48	100					48	

TABLE IV.

Composition as to age groups and relative maturity of a collection of 51 females taken by traps in Baker Bay, Columbia River, July 3, 1919.

Age groups	Number of specimens and per cent which would mature during:						Total	
	Year taken		Following year		Second year following			
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Ocean nuclei—								
In 3d year	1	100					1	2
In 4th year	24	100					24	47
In 5th year	17	100					17	33
In 6th year	3	100					3	6
Stream nuclei—								
In 3d year			1	100			1	2
In 4th year	4	100					4	8
In 5th year	1	100					1	2
Totals	50	98	1	2			51	

TABLE V.

Composition as to age groups and relative maturity of a collection of 41 females taken by beach seines on Sand Island, Columbia River, July 7, 1919.

Age groups	Number of specimens and per cent which would mature during:						Total	
	Year taken		Following year		Second year following			
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Ocean nuclei—								
In 2d year					5	100	5	12.4
In 3d year	1	50	1	50			2	4.8
In 4th year	20	100					20	48.8
In 5th year	8	100					8	19.5
Stream nuclei—								
In 3d year					4	100	4	9.7
In 4th year	1	100					1	2.4
In 5th year	1	100					1	2.4
Totals	31	76	1	2	9	22	41	

TABLE VI.

Composition as to age groups and relative maturity of a collection of 102 females taken by troll off the mouth of the Columbia River, August and September, 1918.

Age groups	Number of specimens and per cent which would mature during:						Total	
	Year taken		Following year		Second year following			
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Ocean nuclei—								
In 2d year			1	20	4	80	5	5
In 3d year	21	84	4	16			25	24.5
In 4th year	19	95	1	5			20	19.5
In 5th year	19	100					19	18.5
Stream nuclei—								
In 3d year			2	100			2	2
In 4th year	3	100					3	3
In 5th year	27	100					27	26.5
In 6th year	1	100					1	1
Totals	90	88.3	8	7.8	4	3.9	102	

TABLE VII.

Composition as to age groups and relative maturity of a collection of 95 females taken by troll off the mouth of the Columbia River, August 13, 1919.

Age groups	Number of specimens and per cent which would mature during:						Total	
	Year taken		Following year		Second year following			
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Ocean nuclei—								
In 2d year			1	50	1	50	2	2.1
In 3d year	9	60	6	40			15	15.8
In 4th year	63	95.5	3	4.5			66	69.5
In 5th year	4	100					4	4.2
Stream nuclei—								
In 3d year			1	100			1	1.1
In 4th year	6	85.7	1	14.3			7	7.3
Totals	82	86	12	13	1	1	95	

TABLE VIII.

Composition as to age groups and relative maturity of a collection of 63 females taken by troll in Monterey Bay, June 19 to 21, 1918.

Age groups	Number of specimens and per cent which would mature during:						Total	
	Year taken		Following year		Second year following			
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Ocean nuclei—								
In 2d year			1	50	1	50	2	3.2
In 3d year	15	29	36	71			51	81
In 4th year	6	100					6	9.5
Stream nuclei—								
In 3d year			1	100			1	1.6
In 4th year	3	100					3	4.7
Totals	24	38	38	60	1	2	63	

TABLE IX.

Composition as to relative maturity of a collection of 144 females taken by troll in Monterey Bay, California, June 29, 1915. Determined from a study of the eggs alone.

Age groups	Number of specimens and per cent which would mature during:		
	Year taken	Following year	Second year following
Number	108	35	1
Per cent	75	24.3	.7

TABLE X.

Composition as to relative maturity of a collection of 64 females taken by troll near Drake's Bay and Fort Bragg, California, July and August, 1918. Determined from a study of the eggs only.

Age groups	Number of specimens and per cent which would mature during:		
	Year taken	Following year	Second year following
Number	43	18	3
Per cent	67	28	5

From the data contained in these tables the following generalizations may be made:

1. The fish taken in the ocean off the mouth of the Columbia River contain, in the spring and early summer, approximately 70 per cent of individuals which will not become sexually mature for one or two years.

2. By the middle of August this condition has changed so that nearly 90 per cent are fish which will soon enter the river for the purpose of spawning. The rate at which this change takes place and the time at which it occurs have not yet been determined, but will be taken up in the later report.

3. A comparatively small percentage of the fish found just within the mouth of the Columbia River are immature. It should be mentioned in this connection that it is only occasionally when unusual tidal conditions obtain that any immature fish are taken inside the mouth of the stream.

4. The fish taken by troll in Monterey Bay in June contain a considerable proportion of immature individuals. The data obtained in 1918 are most reliable, and indicate that only about 40 per cent of the fish taken would have spawned during the same year. The data for 1915 indicates that 75 per cent were mature, but selection may well have taken place in making this collection which, as noted above, consists of egg samples only.

5. The fish taken near Drake's Bay and Fort Bragg in July and August, 1918, contain approximately 30 per cent of immature fish. It is of interest to note that this is an approach to the conditions found off the mouth of the Columbia River in August and suggests that the composition of all the schools found near the coast changes materially during the summer season.

GEAR USED FOR SALMON TROLLING IN CALIFORNIA IN 1920.

By W. L. Scofield.

Object. These notes, by no means complete, are intended to be a rough record of the type of gear used in open sea salmon trolling in California at present (1920) as a partial supplement to the system of triplicate receipts for statistics of catch recently installed by the Fish and Game Commission. The fact that gear and methods have changed decidedly in the past few years and no doubt will continue to change makes this summary necessary.

The notes deal chiefly with *gear* used. Such subjects as history of trolling, points at which trolling is practiced and its extent, location for trolling in a given local area, prospecting for schools, and deep vs. shallow fishing, although most important, are omitted or merely touched upon here.

Variation in Methods. There is considerable variation in methods and equipment, with great divergence of opinion on most of the subjects taken up in these notes. While the industry was new this was an advantage, as established custom did not limit experimenting,

but the results of the experimenting were not kept in definite form to be used, each fisherman satisfying only his own opinion without giving others the benefit. As a result there has been much duplication and improvement has been slower than need be. As fishing practice is now more established future improvements will result from more accurate experimenting with definitely recorded results.

Location for Trolling. Most of the fishermen move from one region to another following the salmon runs. The Monterey season opens first (January or February) and the local Monterey fleet is doubled or trebled by boats that go down from northern points, chiefly from San Francisco. Toward the end of the Monterey season (June) these boats begin leaving for San Francisco. They either fish for a time out of San Francisco or Point Reyes or go on up the coast to Bodega Bay, Fort Bragg and Shelter Cove. About August they begin returning to San Francisco. This year several boats, after completing the season at Shelter Cove, went farther north, some bound for Astoria.

In a given region the greatest and most difficult single factor in success is picking the good place to troll. Some days the big catches are made near shore in shallow water. At other times the trolling is best far out in deep water. In Monterey a quite generally believed theory is that schools come up from the south, enter the bay to feed for a few days and then leave. Other fishermen cite cases where the schools come from the north. Some fishermen prospect far out in order to locate entering schools. Cases are known where such a school has been fished day after day on its way to Monterey and while in the bay. Other schools have been followed far up the coast.

In the choice of location most fishermen merely follow some "hunch" and go it blind, keeping an eye on the other boats till they see someone landing fish and then go to that locality. When a large school is biting the whole fleet is often bunched in a small area. A plan often followed at Fort Bragg is to start trolling near shore with a shallow set and work farther out, gradually increasing the depth of line while prospecting for a school. Undoubtedly the successful fishermen have gathered a great amount of knowledge from experience but these "trade secrets" are not discussed freely. A knowledge of the habits of sardines, anchovies and squid is undoubtedly a help to some fishermen. Little is known of the effects of local currents carrying food and the consequent behavior of salmon.

Deep vs. Shallow Fishing. The most successful fishermen experiment at different depths and prospect to locate schools. It is a common saying that small Chinooks are caught more often in shallow water near shore. Silver salmon are said to be caught near the surface. There are, however, many exceptions. Some days when the fish are feeding actively the large Chinooks are caught near the surface. A common method of prospecting is to set one line with two to five fathoms of main line out (above leads) and the other line set with 10 to 20 fathoms out. Good catches are made at a great variety of depths on different days and practically nothing is definitely known of the reasons. Whether or not different schools feed differently is not known. Whether or not the weather affects the depth is not known, but some fishermen work on the theory that deep fishing is best on a clear bright day and that the set should be shallow for

cloudy dark days. This suggests the possibility of plankton sinking to greater depths on clear days, small fish following the plankton and salmon following the small fish. Practically nothing is known of the effect on salmon of different water temperatures. Color of the water is believed by fishermen to be important. Clear water is believed to be poor for salmon fishing and at such times deep fishing is said to be more successful than shallow. Dark, murky or even reddish water is thought to be best for salmon catches and can be fished nearer the surface. The "red water" of deep color sometimes seen along shore is not good for trolling.

Boats. The type of boat most used is a clipper bow boat of wide flare forward and a pointed compromise stern. Often there is a small cockpit near the tiller and a high narrow house open at the back that is little more than a wind and spray screen when standing at the wheel near the engine. As the change from sail to power fishing has been recent there are a number of converted sailboats in use, especially the small Mediterranean type of boat that formerly used a latine sail. There are also a number of converted pleasure boats of a great variety of types. The pointed stern is usually favored rather than a rounding fantail stern because with the narrow stern it is easier to haul a fish up alongside on either side while still operating the tiller. The first troll boats were square sterns. Then the rounding or fantails were found to be better suited to landing the fish as there were no corners for the line to catch on and the stern is low in the water. The low stern was not so good when the boats began going out farther in rough water. Now that two-line fishing is almost universal the bluntly pointed compromise stern is used most.

As fish are becoming less plentiful the tendency has been to use increasingly larger boats capable of going farther out with comfort. The clipper bow type ranges in size from 20 to 40 feet over all with 30 feet as about the average size. The few 40 foot boats usually fish four poles.

The older boats have only a small hatch forward to allow a man to crawl below deck. A recent tendency toward comfort has been to raise the forward deck to allow more room below and a number of boats now have a low house extending forward with portholes to admit light and air. This could be more general since the forward deck is not used except for stowing the anchor and chain.

Nearly all boats carry but one fisherman. The larger boats fishing four lines sometimes carry two men, one handling the starboard lines and the other the port, but frequently one man operates the boat and handles four lines. The catch of a large boat is usually not equal to the catches of two smaller two-line boats, so experienced fishermen prefer to fish alone and not divide profits. Many of the one-man boats are decked over the stern and this is much more dangerous for the fisherman than having a small cockpit. The gunwale is only three or four inches high, the deck is wet, the boat rolls in a rough sea and while landing a fish the fisherman often has to keep one leg on the tiller so that his chances of going overboard seem fairly good, and once overboard with the engine running and his rubber boots too heavy for swimming, his only chance is to be picked up by some other boat.

Engines. Boat engines are of one and two cylinders, the majority being one-cylinder. The two-cylinder engines are nearly all 12 horsepower. The one-cylinder engines develop 6 or 8 horsepower capable of giving a boat speed of about seven miles per hour. The Hicks engine is the most popular engine for trolling boats, but there are many Standard engines in use. In all there are about 20 different makes used, including the Ford automobile engine. Eastern engines built for pleasure boats are also used, such as the Buffalo and Scrips. Most of the boats under 30 feet long have a one-cylinder and boats over 30 feet have a two-cylinder engine.

Speed of Boats. When trolling the engine is choked down till the boat travels at from 2 to 4 miles per hour, 2½ to 3 miles is usually preferred. The speed is greater when fishing near the surface. The deeper the lines the slower the boat is run. This is partially based on the theory that the fish on the surface are more active in taking bait or spoon and that fish deeper are more easily tempted by an object moving more slowly. A greater influence in slowing down for deep fishing is the fact that the line may be given a deeper set with the addition of but few extra weights. The slower the speed the deeper the set for a given amount of leads and hauling in a deep set, heavily weighted line on a rapidly moving boat with the resulting water drag on the line is back breaking work, so that the theory of deep fish being more sluggish fits in nicely. The speed is greater when fishing spoons rather than bait is used. Most spoons do not have the proper motion (spinning or side to side weaving) when the boat is run as slowly as is customary in bait-fishing.

Poles. Poles are made from young peeled saplings, seasoned and trimmed down, usually of pine, eucalyptus or Douglas fir. Many bamboo poles are used, a single large pole or three small diameter poles lashed together. Often a short section of bamboo is lashed to the pole near the tip as a reinforcement at the point where a break is most apt to occur.

For small boats a general rule is to have the length of pole equal to the length of the boat as this is believed to give better balance. Boats using four poles have two short poles forward and two very long poles aft. Twenty-five feet is about the average length of pole.

Placing of Poles. Since there are many different styles of boats used there is great variation in the arrangement and position of the poles on the boat, each fisherman following his own ideas to best fit the deck plan of his boat. In some cases the poles are far forward, in most cases amidships and in some cases far aft. When the boat is small and of narrow beam the poles are usually crossed so that the base of the starboard pole rests in the scuppers of the port gunwale. This arrangement does not require a mast. In large boats the poles are used with a short mast, the base of the pole fitting into a socket or bolted at the foot of the mast. Since the distance from the mast foot to the gunwale is short, the pole when under strain has a great leverage. The strain is relieved by guy lines run from the bows. When very long poles are used even on larger boats they are sometimes crossed thus giving a longer pole base support within the boat.

Pole Supports. In all cases the pole has a vertical support on the gunwale to give the tip the necessary elevation. These supports may be simply two boards nailed together like a letter X, or a single board

with a U notch cut in the upper end to receive the pole. Some have a notch cut to curve aft so that the pole jams in and is held down tight when the boat rolls violently. Other supports are made by bending the end of an iron rod into a U-shaped receiver for the pole.

Stowing Poles. When not trolling the poles are seldom left spread because of the danger of being broken. In some cases they are laid on deck along the gunwales, sometimes lashed to the top of the house with their bases in the bows, often drawn up vertically beside the short mast, fitting in notches at the mast head. Sometimes the pole base is hinged so that the poles may be lowered aft against the top of the house. In a few cases the mast is set on a hinged base so that mast and poles may be lowered at night or to pass under a bridge.

Pole Line. In trolling the main line is not attached to the pole directly. There is a short large-sized line or "pole line" with one end tied to the pole tip and the other end provided with a snap hook which is snapped into the main line at any desired point. The upper portion of the main line then hangs loose from the snap to the stern of the boat and provides a very convenient method of pulling in the line, since the pole line and snap are from 15 to 25 feet out from the stern while trolling.

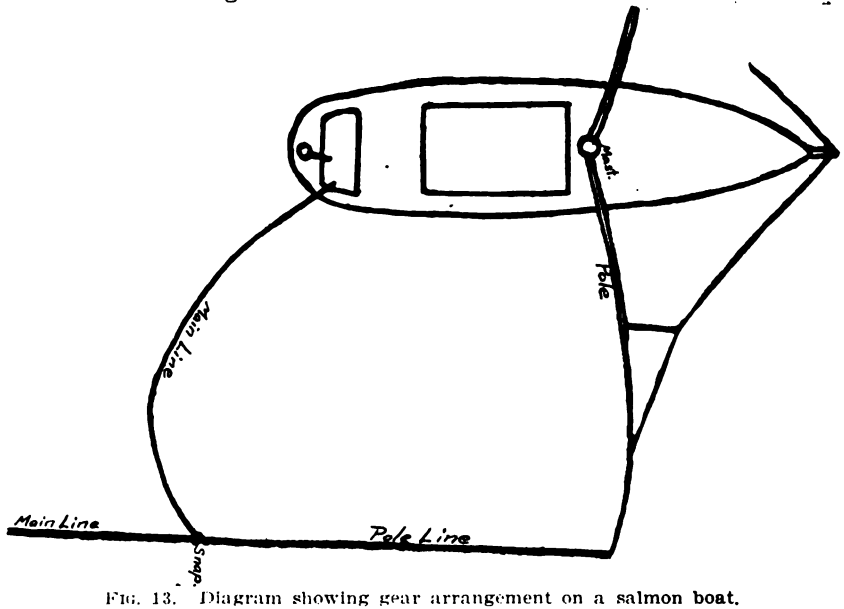

FIG. 13. Diagram showing gear arrangement on a salmon boat.

The pole line is a few feet longer than the pole so that it may be unsnapped from the main line and snapped into a cord loop on the gunwale near the stern when the main line is being hauled or when the poles are stowed against the mast. This arrangement easily allows the main line to be fished at any desired depth. The snap may be used in the loop of any lead or in loops tied in the main line two and one-half or five fathoms apart. The main line loop is made by doubling back the line and tying a simple hard knot leaving two or three inches free to form the small loop, just enough to receive the snap conveniently.

Plan of Rig. Although there is great variation in details of the arrangement of weights and line the "taper line" is almost universally used. The taper line is heavy (large) at the top, tapering in size toward the bottom. The size of the leads also tapers off, with the lightest at the bottom. The object of the tapering size of line is largely to avoid loss of the whole line when the lower hooks catch on rocks.

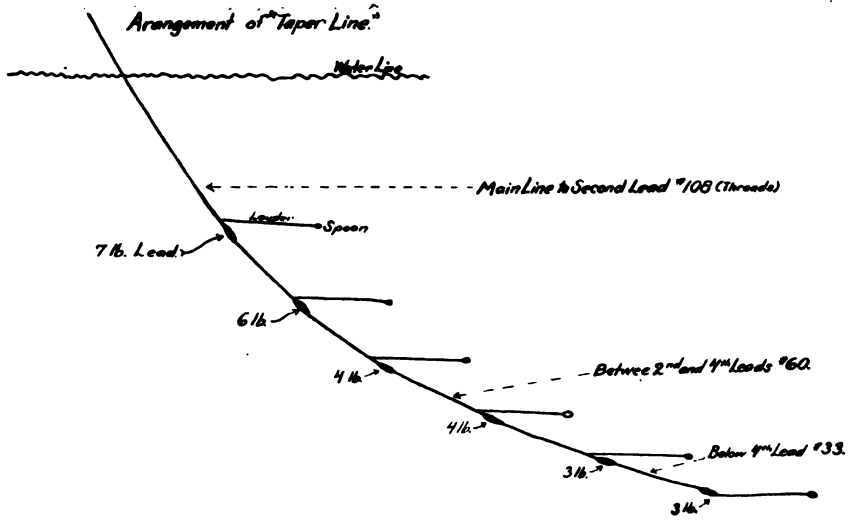

FIG. 14. Diagram showing arrangement of a taper line.

The strain breaks the line only part way up so that only the bottom portion is lost. Also the decreasing size of line and leads decreases the water drag on the lower portion where the drag is hardest. The tapering size of leads toward the bottom has the effect of allowing the far end of the line to trail out more nearly approaching the horizontal, thus bringing the bottom three or four hooks within a more limited vertical range. This plan of rig allows great variation in depth of fishing without changing the rig. When it is desired to fish near the surface the bottom three leads and leaders may be paid out, the lightness of rig being an advantage. To increase the depth, one or two more leaders are paid out. When all leaders are out the depth is increased by paying out more main line (up to 10 fathoms. Over 10 fathoms greater depth is best obtained by adding more lead).

When a school is located the depth of the school may be determined by noticing which hook is taken and the taper line is then lowered till the second or third hook from the bottom is at the determined depth. Thus the bottom four hooks are brought close to the desired depth.

In taper lines the size of the line is tapered by three or often four changes in size. There is no uniform plan of taper lines approved more than another. An arrangement often used is a No. 108 main line to the second lead from the top, No. 60 line between the third and fourth leads and No. 33 or No. 30 below the fourth lead. (See paragraph on Line Sizes.)

Another plan of rig rarely used is very different from the taper line in that the object is to have the hooks fall at approximately equal distances apart vertically instead of within a limited vertical range. In this plan a uniformly heavy line is used (No. 144 for example) with the leads arranged just the opposite to the taper-line plan, that is, the lighter on the top and the heaviest at the bottom. With this arrangement the line is more nearly vertical and can be given a deeper set than the taper line. This line offers the greatest resistance in the water and if snagged on the bottom the whole line, with all the hooks and leads, may be lost.

Number of Lines Used. The number of lines used from a single boat varies from one to four with two as the usual number. Early in open sea trolling one line was used but is seldom seen now. Nearly all boats use two poles with a line from the tip of each pole. An occasional boat fishes a third line directly astern but this line is lightly weighted to keep near the surface. An occasional boat fishes four lines from *two* extra long poles, in which case the two additional lines are attached about midway out the pole. Several of the largest boats fish four lines from four poles, two short poles placed well forward and two long poles placed about at the boat's greatest beam in order that these lines may be as far out as possible to avoid tangling with the forward lines.

Whatever the arrangement of lines, care is used to keep the lines separated to avoid tangling while set or while hauling in. The fisherman stands in the cockpit or on the deck far aft so that he may control the tiller with his foot while hauling in. In good weather the tiller is often disregarded but in a strong wind or current a fairly straight course is kept because a sharp turn is apt to tangle lines.

Number of Hooks per Line. The number of hooks used on each line varies from one to nine but five or six is the usual number. Most of the lines are rigged with six hooks (or spoons). Lines rigged with nine hooks are sometimes used in prospecting but when fish are located and fishing is begun the number is reduced by removing leaders and leads. A two-hook line is occasionally used in surface fishing.

Line Sizes. The line commonly used is a cotton seine-line which is made in three grades, soft, medium and hard laid. For trolling the hard laid line is used. Practically all line used is made up of three strands twisted, each strand being made up of a number of threads. A four strand line is rarely used. The sizes of line are designated by a number which represents the total number of threads. For example No. 30 is a line of 10 threads to each of the three strands. Up to No. 36 the sizes are numbered at the addition of each three threads, as No. 21, No. 24, No. 27, etc. From 36 to 60 the addition of six threads is used in numbering, as No. 36, No. 42, No. 48, No. 54, No. 60. Above 60 the size numbers designate the addition of twelve threads as No. 60, No. 72, No. 84, No. 96, No. 108, No. 120, No. 132, No. 144, No. 156. The sizes of line commonly used range from No. 21 to No. 156.

The main line varies greatly in size according to the arrangement of leads. With a deepset heavy weight line No. 132, No. 144 or No. 156 is used. The upper portion (above the leads) of a "Taper Line"

varies from No. 84 to No. 156 but sizes from No. 108 to No. 144 are more frequently used.

Leaders are No. 21 to No. 42 but Nos. 27, 30, 33 and 36 are the usual sizes, No. 30 being used most.

The bottom portion of the taper line is usually the same or more frequently one size larger than the leaders. Some taper lines have a different sized line between each two leads, as for example from the top downward, No. 144, No. 108, No. 84, No. 60, No. 48, No. 36. Light taper lines generally use only three sizes as No. 108 to the second lead from the top, No. 60 between the second and fourth leads and No. 33 below the fourth lead. A more frequent arrangement of sizes for taper lines is four sizes—No. 144 to the first (top) lead, No. 108 from the first to third lead, No. 60 from third to fifth lead and No. 33 below the fifth lead.

The size of line makes no apparent difference in the catch. Evidently the fish are no more wary of a large line than of a small. The line must be strong enough to hold the strain of a fighting salmon added to the resistance of line and leads in the water. Beyond this the individual preference of the fisherman determines the size. The very large lines are better in that they do not cut the hands so much while hauling in but they offer a decidedly greater resistance in the water and require harder pulling and more lead.

Color of Lines. Opinions are conflicting as to the best color for lines. Some fishermen use the white untreated line as it comes from the store. Most fishermen tan the lines brown, more for the purpose of preserving than making the line invisible. Some fishermen dye the lines green, believing that this color decreases visibility and insures better catches. Blue line is sometimes used. Many fishermen believe that color makes no difference in the catch.

Depth of Lines. On a two-pole boat the poles are usually elevated so that the line enters the water at a point about opposite the boat's stern. The line usually enters the water at an angle to the water surface of 30 to 45 degrees. Water resistance then curves the line astern. The taper line curves astern till the bottom of the line is nearly horizontal. The actual depth reached by different types of line is not known and makes no particular difference to the fisherman except in avoiding snagging rocks. He is chiefly concerned with the relative depth for his plan of rig, that is, how much line to pay out to bring his hooks to the depth where fish are biting best that day. A six-hook taper line with six fathoms between leaders means 30 fathoms of line. This line is fished with from 0 to 40 fathoms of line (above top lead) so that a total of 70 fathoms of line may be out in extreme cases but the greatest actual depth reached is probably not over 30 fathoms assuming the average angle of the line to be about 25 degrees to the water surface. This is an extreme case since 25 fathoms of main line (above leads) is generally the greatest amount used and 5 to 10 fathoms are most frequently used. With 10 fathoms out (40 fathoms total) the usual depth reached is probably 20 fathoms.

With the ordinary arrangement, a total of 27 to 30 pounds of lead and 10 fathoms of main line (above leads), the paying out of more main line does not materially increase the depth because the water resistance to the large line merely trails the whole gear astern. A greater

depth is then obtained by adding more lead rather than more main line. The size of the main line is an important factor in depth because a given weight will take a small line much deeper than a large line.

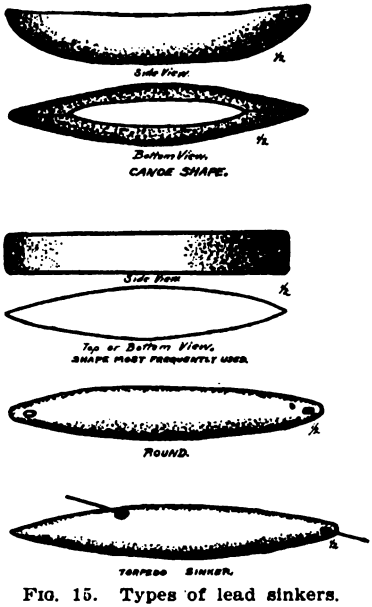

FIG. 15. Types of lead sinkers.

Leads. Although suitable lead weights may be purchased, they are usually home-made, an easy method being to bend two pieces of strap iron into a rough boat shape pointed at both ends and pour in the molten lead, using a sheet of paper over sand for bottom. Some leads are made rounded and pointed at each end. Others are quite carefully moulded in boat shape with the bottom tapered back and smaller than the top. This canoe shape is intended to ride upright with the least possible resistance to the water but it fails of its purpose because it is supported at an angle by the main line and its points of attachment, being near the top, allows the bottom to shear off to one side (skate). The result is that the weight meets the water broadside instead of bow on as intended. The lead cast in a rough boat shape with straight bow and stern with top and bottom the same size and shape is the lead most used because it rides straight without skating, is the simplest and easiest to make and does not roll on the deck. It is generally agreed that the best possible shape is the round lead (cigar shape) elongated and pointed at each end. This lead offers the least possible resistance to the water and therefore greater depth can be had with less weight, but it has two disadvantages, the greatest of which is that it rolls on the deck and is a great inconvenience in tangling up the lines when on deck. It is also expensive to buy or, if home-made, very difficult to mold.

Boats coming down to the California coast from the north (especially the Columbia River boats) frequently carry much larger leads, a common shape being a round lead of large diameter, slightly elongated with bluntly rounded ends, the lead being more the shape of a keg than a cigar. This same general shape is sometimes used slightly flattened but this shape usually sheers off so that the lead meets the water broadside. Another lead occasionally seen is a very large round lead pointed at one end and perfectly flat at the other, giving the shape of an old style beehive.

Another type of lead is credited with obtaining the greatest depth for a given weight. This is the "torpedo sinker," cigar-shaped but the forward attachment to the line instead of being at the pointed end is about one-third of the way back on one side (top) of the lead. This method of hanging allows the forward point to dig downward into the water with the tendency to deepen the whole line. The objections to this lead, aside from the difficulty of rigging it, are that the free point tangles the line on deck, the lead rolls on deck and when in

the water it gathers up floating seaweed in the angle formed by the line and the free point of the sinker.

The weight of a single lead in most cases varies from 2 to 10 pounds the usual weights being 3, 4, 5, 6, and 7 pounds. Occasionally a metal ring is cast in the lead for convenience in attaching the line, but this is apt to cut the line. The usual method is to bore a hole through the end of the lead and tie in a short piece of heavy line leaving a long loop or "strap" into which the main line may be tied with a bowline. An occasional fisherman rigs his leads with a swivel snap at each end so that the lead may be easily exchanged for a lead of a different size. This would be particularly convenient in prospecting and experimental fishing.

Amount of Lead. There is little uniformity in the total amount of lead used, each fisherman having his own ideas. Lines carry from 4 to 40 pounds of lead, 18 to 35 pounds being the most general range for taper lines of 6 hooks, with 27 pounds as the weight most frequently used. For surface fishing as little as four pounds of lead (two 2-pound leads) is sometimes used on a two-hook line.

In taper lines no arrangement can be considered typical but the weight is often distributed somewhat as follows from top to bottom—7, 7, 6, 5, 5, 3, totaling 33 pounds. Fishermen preferring less weight have some such arrangement as 7, 6, 4, 4, 3, 3, totaling 27 pounds. A frequently used total weight for a six-hook taper line is 29 pounds arranged 8, 6, 5, 4, 3, 3, pounds. Many of the fishermen that fish five hooks use as much or more lead than on the six-hook lines. The arrangement on such a five-hook line is frequently 10, 8, 4, 5, 3, totaling 30 pounds. Heavy deep set lines, though rarely used, are arranged from top to bottom somewhat as follows—4, 5, 6, 7, 7, 8, totaling 37 pounds.

On any one line the amount of lead used is not fixed but varies from day to day and may be changed several times during a day.

Leaders. Each hook (or spoon) is attached to the main line by a "leader" or short line 3 to 6 fathoms long. The weighted main line extends downward at an angle allowing the unweighted leader to trail out behind horizontally.

The length of the leader depends on the distance between leaders on the main line, the leaders being a little shorter than the distance between leaders. This is to avoid tangling in case the boat stops and the lines hang straight down, and also while hauling in the line. The distances used most commonly are 6 fathoms between leaders with a 5½-fathom leader. Another plan of rig frequently used is 3½-fathom leaders placed 4 fathoms apart. This rig with 4 fathoms between leaders allows more hooks within a limited vertical range when a school is located and found to be biting at a fairly uniform depth.

Attachment of Leader to Main Line. Leaders are attached to the main line from one to two feet above the lead sinkers, the usual distance being 18 to 20 inches. When ocean trolling for salmon started on the coast, it was the practice to attach the leader to the loop at the upper end of the lead but it was found that a hooked fish in fighting would tear loose from the hook because the heavy lead supported by the taut line offered too much resistance to the sudden jerk. For this reason the leader is a little above the lead so

that the taut main line will give more spring to the sudden jerking of the fish. The bottom leader is usually attached to the bottom of the last lead in taper lines and in order to offer a less solid resistance to the fighting fish a light rather than a heavy lead is used at the bottom, a three-pound lead being most frequently used.

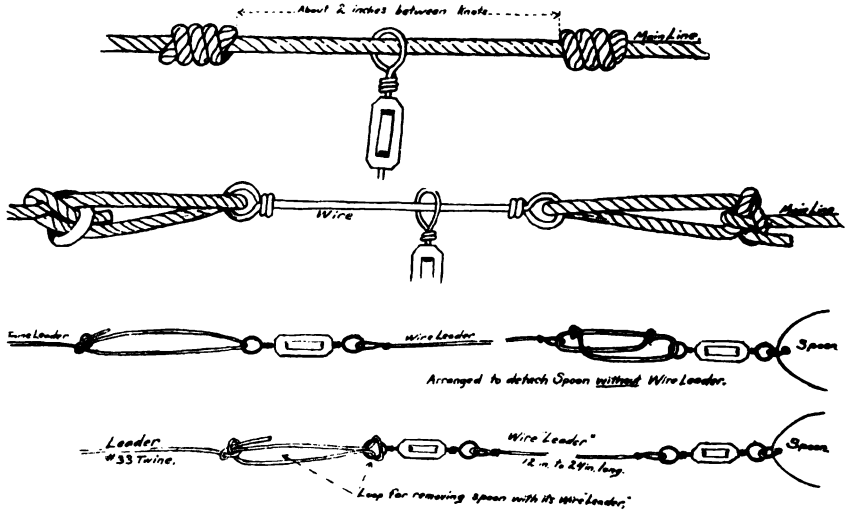

FIG. 16. Diagram showing method of attachment of leader to line.

The usual method of attaching the leader is to tie a "running knot" in the main line which leaves the line straight as if threaded through three or four wraps of itself. The name "running knot" refers to the fact that the line runs straight through but the knot itself is perfectly solid. The line is then threaded through one ring of a swivel and another running knot tied at from two to four inches from the first. The leader is then tied into the other ring of the swivel with a bowline. The swivel protects the main line from being twisted by the leader and the distance between knots allows some play for the leader without crawling up or slipping down. The wire ring of the swivel is apt to wear on the lower knot and to avoid this a short wire section is sometimes inserted in the main line. This wire is about two inches long, threads through a swivel ring and looped at each end with the ends wrapped into a shoulder to keep the swivel. The main line is tied with a bowline into each loop of this wire section. By this arrangement the swivel plays on wire but the strain of the whole line now falls on the loop of the bowline bearing on the wire loop and this is apt to cut under a heavy strain.

Bait vs. Spoons. There is the greatest divergence of opinion among fishermen on the relative merits of spoon and bait. One fisherman will remain in because no fresh bait is available, another will use nothing but spoons, another insists on having both, while most fishermen change from one to the other at different times in the season. At Fort Bragg, for instance, there is a general belief that the spoons are more successful during the early part of the season and that bait is better for the latter part of the season. The majority of fishermen

prefer fresh bait, but when it is difficult to get or expensive, they use spoons. At Monterey most of the Japanese prefer spoons throughout the season and most of the white fishermen prefer bait at all times even when it has to be purchased at from 75 cents to $2 a bucketful.

A few half-hearted experiments have been tried by using one line baited and the other rigged with spoons, but such trials have been brief and the findings merely personal opinion rather than actual figures of the catch.

A fresh sardine about seven inches long is almost universally preferred as bait. Squid tear off the hook. Anchovies are too small. Salted and formalin-preserved sardines are occasionally used but without much success, generally attributed to the loss of the bright shining appearance of the fresh fish.

Spoons. A variety of spoons are used, no one being a universal favorite. A number of fishermen prefer the hook attached solidly to the spoon (as in the Dubrow) because they believe that the salmon is more apt to be hooked, claiming that the swinging hook is apt to be brushed aside. Some fishermen prefer the Wilson spoon with a free swinging hook that is attached about one-third of the way up the spoon, because they believe this arrangement is more apt to hook the fish. However, most makes of spoons have the hook swinging from the lower end of the spoon, as in the McMahon, Diamond and Kewell-Stewart.

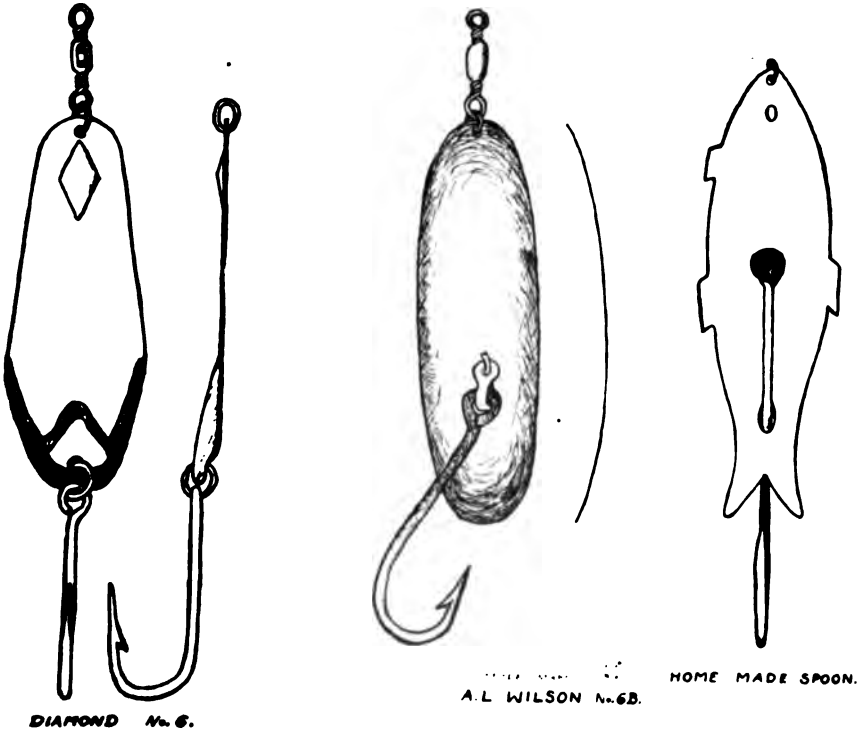

FIG. 17. Various types of salmon spoons.

The chief consideration in any spoon is its shape to govern its motion in the water. Although the spoons are of polished silver plating or brass to attract salmon by their shining, it is their action in the water resembling a swimming sardine that is most important. Some spoons are designed to spin in the water with a wriggling motion. Most spoons zigzag while constantly tipping from side to side so that the broad shining surface is displayed as often as possible. The Dubrow spoon for instance is curved to give a zigzag motion when trolled slowly and the tails are curved propeller fashion to spin the spoon when moving more rapidly. The McMahon spoon was the most popular at Fort Bragg during the 1920 season. This spoon tips rapidly from side to side when trolled and follows a fairly straight course. This tipping is continued even when the speed is greatly slowed down and the McMahon's popularity is largely due to the fact that it can be trolled slower than most other spoons. The Stewart and Wilson spoons tip less from side to side but follow a more zigzag course. Fishermen who have used Dubrow, Wilson, Stewart and McMahon spoons almost equally throughout a season claim to have had equal success with all four spoons but favor the McMahon because it is successful at a slower speed. There are quite a few home-made spoons in use, the spoon being cut from a sheet of plated brass. A successful home-made spoon is made on the Dubrow plan by riveting in a No. 11 or No. 12 long-shanked eye hook. Home-made spoons of the Kewell-Stewart type are most frequently used and are more easily made than the other types. The Wilson type is also seen frequently and is comparatively easy to make.

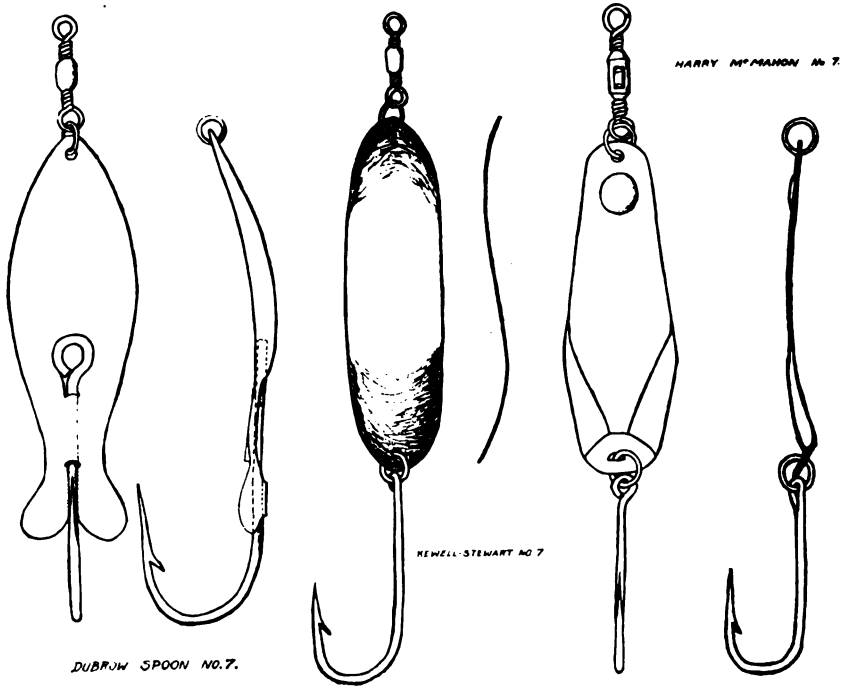

FIG. 18. Various types of salmon spoons.

The size of the spoon does not vary greatly, No. 6 and No. 7 being the favorites. McMahon No. 7 is used most although some No. 6 are used. The No. 6 Dubrow is used more than the No. 7. In Kewell-Stewart spoons No. 7 is used most. In Diamond spoons, No. 6 is preferred.

Bait Hooks. When fresh bait is used (sardines almost universally) the hook is passed twice through the head (through the eyes) of the sardine so that a couple of firm hitches are made on the head by the line. The sardine is then bent to one side at about the same curve as that of the hook and the hook passed through the body longitudinally, in at the mouth and the curve of the hook out at the anal opening leaving the shank of the hook inside the body. Because of this preferred method of attaching the bait a *long* shanked hook with a knob head is used. The knob, much like the head of a finishing nail, is the diameter of the shank and is formed by the shank diameter being reduced just below the knob.

Many of the hooks are made in Norway, especially the Kirby hooks, which have a slant to one side in addition to the curve so that the point sets at an angle to the shank. Most fishermen prefer a straight hook without the side slant and the Kirby hooks are often straightened in a vise before using. In all hooks the point is considered to bend in too sharply toward the shank and most fishermen bend the points outward a little before using.

When using a short-shanked hook the bait is more apt to be swallowed by the salmon and the hook is then difficult to extract and the leader is more apt to be cut on the teeth of the fish. A hook with a large diameter at the curve is preferred because it is less apt to tear out of the salmon's mouth.

The sizes used range from No. 9 (small) to No. 13 (large), sizes 11, 12, and 13 being used most. There is a quite general belief among fishermen that the first of the season runs small fish and the end of the season large fish. Some fishermen therefore use No. 11 sized hooks at the first of the season and No. 13 toward the end of the season. No. 12 is the most popular size for bait hooks.

FIG. 19. Kirby hook No. 12. Natural size.

Hook and Spoon Leaders. A No. 33 cotton leader attached to the hook knob would be too large for convenient threading through the bait. For this reason a short hook-leader is used, a line of Irish linen

being preferred as it is small, light, pliable, and strong. The most popular make is the Cuttyhunk, a three-strand linen bass line. The sizes used range from 24 to 60 but the sizes 27 and 42 are used most although all sizes between are occasionally used. For hook-leaders a No. 6 or No. 7 Irish flax salmon thread doubled is sometimes used. Other fishermen use No. 7 airplane thread doubled and twisted. Such thread is attached to the hook by taking a piece four or five feet long, making a double half or clove hitch over the hook knob in the center of the thread and twisting the ends.

The length of the hook leader varies from one and one-half to three feet, two or two and one-half being preferred by most fishermen.

A swivel is used between the hook-leader and main cotton leader, using a bowline at each end of the swivel. Some fishermen think that the loop of the bowline over the Cuttyhunk leader cuts in and weakens the leader, so they double back the end and tie a plain hard knot in the doubled Cuttyhunk. This may be attached to the swivel end by inserting the loop through the swivel eye and threading the hook and leader through the free end of the loop, making a reef hitch. This hitch also has the advantage that the hook and its leader may be removed by unthreading without untying any knots. This same hitch is frequently used at the lower end of the main leader where it attaches to the swivel, especially when a wire spoon leader is used. The main leader is less apt to cut on the swivel eye but the chief advantage is that the swivel, wire leader and spoon may be easily removed without untying any knots.

When spoons are used a Cuttyhunk spoon leader is sometimes used but a short wire leader is usually preferred because the linen thread is apt to be cut on the fishes' teeth and especially when a shark is hooked or is attacking the hooked salmon. For this purpose a two or three foot brass or plated brass wire is generally used, belt lacing wire being the favorite as it is pliable and very strong, but it can be broken if the fish in thrashing about gets a kink in the wire. To avoid this some fishermen use piano wire since it is exceedingly strong and so stiff that it is not kinked and broken, but its stiffness makes it much more inconvenient to handle, especially in removing spoons. In order to overcome this inconvenience some fishermen use some form of home-made stiff wire snap or fastener to free the spoon. This snap is sometimes inserted just below the swivel so that the wire leader is removed with the spoon, or just above the swivel of the spoon so that the wire leader remains attached to the main cotton leader. Some such scheme for easily removing the spoons is a great convenience because the wet spoons soon tarnish when left exposed to the air. To prevent tarnishing the spoons should be removed at the end of the day's fishing and placed in a bucket of salt water or wet sand.

The swivels used are of two types. Most spoons sold in the stores have the closed or barrel type attached but the wire knobs inside the barrel may wear down and break. The open type of swivel is preferred because the wire knobs can be seen through the openings and the swivel exchanged for a new one when wearing occurs.

Markers. In prospecting for a school a boat may be trolling for some time with no sign of fish and then suddenly have two or three strikes at once on each line. By the time the fisherman hauls in and resets each line considerable time has elapsed and the boat has covered

quite a distance. It is then difficult to circle back and pick up the spot where the strikes occurred. Some fishermen carry a marker that may be heaved overboard at the point where the strikes occur so that the place can be picked up again without trouble.

The marker is a small float that supports a light flagged pole 6 to 10 feet long. The lightest marker is a cork float about 18 inches square and 4 inches thick, supporting a bamboo pole. The float is often of wood. The flagpole is passed through the float and weighted on the bottom end to insure floating upright.

Detecting a Strike. The drag of the line bends the pole tip backward. The rolling of the boat causes a motion of the pole tip due to lessening and increasing strain, but this slow movement with the boat roll is easily recognized and not confused with the more rapid jerking of the pole tip when a salmon is hooked.

Stiff poles are more apt to break with the sudden extra strain of a boat roll. In some cases this is obviated by using a coiled wire spring at the pole tip, but springs have not met with general favor.

Landing Fish. Hauling in the line takes some time and the hooked salmon has time to wear himself out fighting against the drag of the leads so that pulling him alongside is usually a hard dead pull without excitement. In shallow short-line fishing the salmon is more quickly pulled in and often puts up a hard fight, charging back and forth, even jumping clear of the water, tangling the gear generally and sometimes wrecking it. Silver salmon are credited with fighting much harder than Chinooks. Small Chinooks are said to fight harder than large fish, but this is probably due to the fact that small fish are more frequently hooked near the surface and on the shorter lines.

Some fishermen use a large landing net to bring the fish on deck, but a gaff hook is more commonly used. Sometimes the fish is so exhausted that he may be landed by a hand inserted in his gills. To prevent the fish flopping on deck he is killed by clubbing over the head with the gaff hook or a special club carried for the purpose.

Hauling in Lines. Practically all hauling in is done by hand. A few fishermen have small drums operated by the engine with rod and gearing, but this power hauling saves only the first (and hardest) pull to the first leader as weights and leaders can not be wound on the drum.

To prevent the line cutting the hands most men wear over the fingers a three or four inch section of automobile rubber inner tubing. The stores sell rubber "clinchers," which are a circular band of thick rubber with a sunken grove for the line and intended to be worn over the hand as is the auto tubing. The clinchers seem to serve better when cut in two and a cord used over the back of the hand instead of the complete rubber ring.

The line is coiled on the deck or in a small cracker box with the hooks inserted in notches in their proper order. The leaders are coiled separately from the main line in a smaller coil near the hook so that the bait or spoon can be thrown far out and tangling avoided.

Lost Fish. An attempt was made to learn the percentage of strikes that are lost but no records are kept and the opinions of fishermen are at such variance that nothing of value was learned. The percentage of lost fish evidently varies from time to time, possibly with the degree of hunger of the fish. Fishermen claim that on some days one-third of the strikes are lost, but on other days practically every fish is landed.

Whether or not small Chinooks are lost more than the large was not determined. The majority of fishermen think that many more small fish are lost than large, but they cannot be sure but that the small fish were silver salmon in most cases. Opinion is agreed that silver salmon are lost more than Chinooks and two reasons are given. Silvers are said to fight harder and their mouths are more tender. It is noticeable in looking over a mixed catch of the two species that many of the silver salmon have the lower jaw torn apart.

Salmon after being securely hooked are often attacked by enemies that are following the school. This is apparently more common in the northern waters, but is not uncommon at Monterey. Sea lions and seals are said to play a part, but sharks are the chief offenders. Sharks are often seen following a hooked salmon while the lines are being hauled in, even coming alongside, pursuing the salmon till he is hauled out on deck. It is no uncommon thing to see a 15-pound salmon delivered that has been bitten in two, leaving only the head and a little of the body on the hook. Spoons, leaders and leads are often lost from sharks biting off the lines and trolling is seriously interfered with, particularly along the northern coast and especially at Nogo and Shelter Cove.

THE FUTURE OF THE SARDINE.*

By WILL F. THOMPSON.

Our greatest fishery is that for the sardine; indeed, it is overwhelming in importance, constituting during January, February and March of 1920 about 85 per cent of the total fish of all kinds taken. Will the sardine remain, or will it vanish at times as does its cousin the herring of the North Atlantic, and as the sardine itself probably does in British Columbia and Alaska? Upon the answer to that question depend millions of dollars and the welfare of a great industry. What are we doing to answer it?

We have not known thus far whether or not our sardine fishery is subject to great fluctuations—its history is so brief, having begun in 1914. It is possible to surmise that it is, because in the North Pacific this same species of sardine was practically unknown until two years ago—indeed the occasional specimen that was taken with the herrings was hailed as a curious stranger. Then they came in a great flood, cluttering the traps and the nets, and a canning industry of importance sprang into being. And if they were lacking once they may well be lacking again, not only in British Columbia but in California. So the most ordinary business sense dictates an energetic inquiry into the probability that such great changes will occur in California, and into the chance of foreseeing them.

This is, you will note, entirely aside from the chance of overfishing. And we do not know enough about our Pacific fisheries to know whether they can stand anything approaching the strain that the Atlantic herring and sardine have stood. Perhaps even in the Atlantic it is possible that the herring or sardine will one day suffer from man's

* California State Fisheries Laboratory, Contribution No. 22.

operations as have other species. Our experiences on this coast have not been reassuring—that is certain—as witness the disastrous story of the halibut and salmon, for which our only great fisheries existed before the sardine and albacore became of importance. But before we can discuss overfishing, before we can tell whether it is happening, we must know something about those great fluctuations mentioned above, which may be confused with it. Indeed, in the sardine fishery the great natural changes in abundance may be so overwhelming as to completely overshadow depletion.

To the study of these changes in abundance we have therefore addressed ourselves earnestly, along lines suggested by a scrutiny of the phenomena in the herring and other fisheries. It has been shown that the relative success of the spawning seasons is of predominant importance in explaining these changes. It has been found in the herring fishery that in some given year the spawning was very successful, and that the result was a vast number of herrings of a single age, and as year after year this great age-group became older it made the fishery very successful for that particular size to which it had attained.

To make this point clear a diagram is attached which, while it does not represent the actual condition in any particular fishery, may for our purposes be thought of as applying to that for the sardine.

The successive years are shown at the various levels, and the ages are shown in succession from left to right. With each passing year the groups fall each into the next higher age class, and thus the predominating group passes successively through the ages from the third to the eighth. The oblique line traces its course. The height of the blocks represents the relative importance of the particular age considered in the catch. It will be noticed that each age-group becomes smaller as the years go on, because of the annual natural death of a certain proportion, in this case assumed to be a fourth.

In the case of the herring a successful period of fishing was ushered in by the incoming of just such a highly successful age group as is first shown in the third year old class on the diagram, and a poor period was characterized by its lack. Such a phenomenon may be happening in our sardine fishery; and we are analyzing the catch to see whether it is or not.

For instance, during last season, the first we investigated, the group we may regard as being in their fourth year predominated and made, at Monterey, a good pack for "half-pound oval" cans, much as the dominating class in our diagram was in 1904. Will this year's catch be of fish one year older, hence less choice, and will the next be of fish two years older? Or will the catch continue to be of the same size and equally good for packing such cans? In other words, do the age-groups of fish vary widely in their abundance, as we have represented in the diagram, and will the fishery vary between success or failure with their growth in size, and with the presence or absence of a successful year? The packer, wondering whether the fishery is to remain good, and whether he will be able to pack "quarter oil" sizes, or obtain good "half-pound oval" sizes, naturally wishes to know the answer. We already have the catch of last year analyzed. What will our analysis this year show? It should, if we obtain our material and know from it

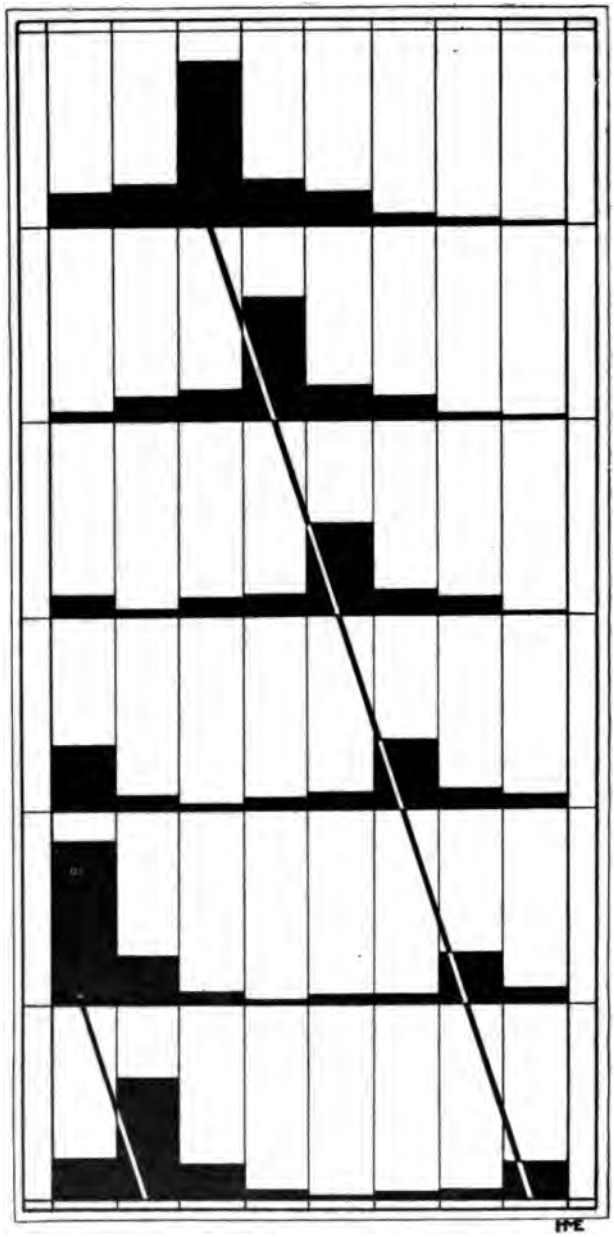

FIG. 20. Diagram showing theoretical effect of an abundant age group on the catch of successive years. The height of the blocks represents the relative abundance. If the diagram is thought of as applying to the sardine fishery, the following classification might hold:

Age I—Too small for canning.
II—"Quarter Oil" sizes.
III and IV—"Half-pound Oval" sizes.
V to VIII—Pound Oval and larger.

whether the predominating class is a year older, answer the questions of the packer, and indicate what we may expect in the future. Perhaps, when we know the exact rate of growth, we may be able to prophesy very exactly the character of the catch. Who knows, indeed?

But note the proviso, *if we know the rate of growth.* That indicates the importance of the fact upon which it is necessary to lavish much care and thought. It is a cornerstone for our edifice. So we are concentrating upon age and rate of growth.

Yet this knowledge of age is not sufficient unto itself. We must know whether our analysis of the catch really shows which age predominates. And there is only one way to do that, namely to take extensive series of samples for observation and comparison throughout the year. So there are two men stationed, one at Monterey and one at San Pedro, who are doing nothing else. Last year we obtained a great series of samples and are subjecting it to the closest analysis to see whether the age that predominates does so because of its actual abundance or because of some influencing factor. And so, also, the same is being done this year for comparison, to see whether the dominating class does become a year older. So far as we know, no fisheries investigation has been based as thoroughly and as carefully as will be that of the sardine.

And so we are confident that we will be able to answer the queries of the packer and the fishermen. We will be able to determine whether or not the fishery is to be one that varies greatly from success to failure through periods of years. We will be able to prophesy, if it is possible, as to the character of the coming catch.

But our objects are also to meet many other queries of the dealer, the packer, the fisherman, the legislator and the public, and what we have said in this article covers but one phase of our investigations; there are others as important. And we hope ultimately to be able to meet competently and scientifically that grave question which always awaits us in all discussions of the fisheries, that of the presence, the absence or the probability of overfishing, and its remedies.

CALIFORNIA FISH AND GAME

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All material for publication should be sent to H. C. Bryant, Museum of Vertebrate Zoology, Berkeley, Cal.

FEBRUARY, 1921.

Ignorance of the law is no excuse for violation of it. Therefore, because of continual changes, it is most necessary that you acquaint yourself with the existing statutes before going afield.

A SALMON NUMBER.

Certain details of the life history of the Chinook salmon, one of California's finest food fishes, have long been a mystery. Does a salmon always return to the stream where it was born? Why do salmon refuse food when in fresh water? Where do the two- and three-year-old salmon feed when in the ocean? Answers to these questions are being sought by scientists to complete our knowledge of the life and habits of this notable fish. In this January issue of CALIFORNIA FISH AND GAME we present a "Salmon number" containing several contributions bearing on the above points which merit thorough perusal by all our readers. Not only are these papers of more than ordinary interest so far as subject matter is concerned, but those by Dr. J. O. Snyder and W. L. Scofield are published results of the marking experiments and other investigations on salmon undertaken by the California Fish and Game Commission.

KLAMATH RIVER SALMON THREATENED WITH EXTERMINATION.

The Electro-Metals Company of San Francisco and Mr. A. P. Seybold of San Francisco, have each applied to the Federal Power Commission for preliminary permits to build dams on the Klamath River to divert water for power projects. One of these projects is located above the town of Orleans and the other a few miles below this place.

Nothing in recent years has so threatened the salmon fishery as these proposals. The Klamath River still has a good run of salmon. A large cannery is located at the mouth of the river and large numbers of fish are used for food by people living along the stream. A large take of salmon eggs for the use of the hatchery is also secured on the Klamath River near Hornbrook. If the Federal Power Commission permits the building of these dams, 90 per cent of the spawning ground of the salmon in this river will be destroyed and ultimately the whole salmon run.

The power companies will argue that fish ladders can be built over the dams. Ladders, of course, could be built, but there is little chance that they would be successful on dams 100 feet high, or over. Furthermore, such fishways would be an impediment to the young salmon attempting to reach the ocean from the spawning grounds. Nor could a successful hatchery be maintained below these dams, for the salmon reaching such a station would not be mature and it would be impossible to hold them until ready for spawning.

The catch in the Sacramento River and other rivers in Alaska has fallen off during the past few years, and unless some of the better streams are protected as spawning grounds for these fish, the salmon will soon be a thing of the past. There is no opposition to power projects in general, but there is opposition to projects which destroy spawning grounds of salmon and other food fishes. Other streams where there is a poor salmon run, as for instance the Trinity River, should be utilized rather than the best of our salmon streams.

It is to be hoped that the above applicants will be denied permits and that the Klamath River and its tributaries will be permanently maintained as spawning grounds for salmon and steelhead, and thus continue to be a source of supply for the fishing industry and a resort for the angler.

IN MEMORIAM.

RALPH W. REQUA.

Ralph W. Requa, a former trusted employee of the Fish and Game Commission, departed this life July 7, 1920. He was born at Xenia, Kansas, November 26, 1874, being the son of George W. Requa, one of the pioneers of Kansas and a prominent citizen and politician.

Ralph Requa graduated from the schools of his native state and at the age of eighteen entered the United States Postal Service as a delivery mail clerk. This work was not to his liking, as he was interested in the conservation of fishes, so he soon entered the employ of the United States Bureau of Fisheries.

For several years he was employed as a messenger in the distribution of fish by the Federal Bureau of Fisheries, and the knowledge he obtained in traveling over the different sections of the United States in this work, was of great value to him later.

Mr. Requa resigned from the Bureau of Fisheries in June, 1895, to accept a position with the California Fish and Game Commission. He was placed in charge of the distribution work at Sisson Hatchery and subsequently became foreman and assistant superintendent, greatly assisting in the building up of this hatchery, as his practical knowledge was of great value in all lines of fish-cultural work. Considerable of his energies were devoted to the improvement of automatic screens for the saving of fish from destruction in ditches and canals, and he patented several devices for this purpose. Many of the best screens in the state have been installed under his direction.

His arduous duties as superintendent of one of the first distribution cars undermined his health and for the last six years he was employed only periodically by the Commission on screens and aquarium exhibitions, although in charge of the salmon experimental work at the experimental station in Bidwell Park near Chico. An expert on the arranging and placing of fish in acquariums, his work at the different county and state fairs attracted wide attention.

He was married to Florence Getchell in 1901. Her death in November, 1918, hastened his end. He left two children, Francis and George Requa.

Untiring in his efforts in all lines of fishculture, there was no day too long or task too hard for him if he thought the work depended on his services. He was one of the faithful employees who have made the work of the California Fish and Game Commission one of the most successful of any in this or any other state.

Ralph Requa was a man of the highest integrity, and his associates will ever remember him as a kind friend and a loyal champion of those whom he trusted as his friends. No nobler tribute can be paid him than the following extract from

Ralph W. Requa.

a letter written by a friend and colaborer of his in the work of the Fish and Game Commission: "He went with me into the high mountains and started me right in the fish planting business. I learned him then, the heart of him, as men will do when all alone in the high country. I formed a strong attachment for him and have always held it. He was another example of a faithful employee, martyr to a cause."

In the passing of Ralph Requa, the state has lost a good citizen, his children, a kind and loving father, and the Commission a dependable and faithful employee.—W. H. S.

THE 1920 BIENNIAL REPORT.

The Fish and Game Commission's 1920 biennial report to the Governor will be off the press early in the year. It is to be bound in an attractive cover giving a four-color reproduction of a Loch Leven trout. The report will contain full statements of the work and accomplishments of the past two fiscal years by department heads, together with many illustrations. The appendix will include statistical reports on fish planting, license sales, arrests, seizures and expenditures. In spite of war economy, the Commission has made a remarkable showing. Outstanding features of the past biennium are: The successful rearing and planting of over 30,000,000 trout and over 26,500,000 salmon; the splendid administration of commercial fisheries and valuable scientific research connected therewith; the establishment of a great chain of game refuges; and a worth while educational and publicity campaign.

SPORTSMEN'S AND ANGLERS' ORGANIZATIONS.

The sportsmen's and anglers' organizations of California or any state may be considered as wild life educational assets. Through them a greater number of people are made familiar with the fish and game laws; right sportsmanship is stimulated and the importance of conservation is better appreciated. The Fish and Game Commission stands ready to encourage these clubs in any way possible, for it feels that by cooperating with them both the sportsmen and the Commission will be benefited; the sportsmen will be more alert to the work of the Commission in its effort to insure the ever increasing numbers of fishermen and hunters with an adequate supply of fish and game, and the Commission by being more in touch with the people, will be better prepared to meet their demands and any lurking spirit of dissatisfaction.

The Commission feels that it can be of service to these organizations by loaning its splendid wild life films (or stereopticon slides) and providing a lecturer to explain the pictures, when desired, and acting as a clearing house for dependable information on game resources, fish and game conditions and fish and game laws.

PROPOSED FEDERAL HUNTING LICENSE.

Those interested in the working out of the Migratory Bird Treaty Act are disturbed over the small appropriation available for the enforcement of the act and the consequent small number of federal game wardens. The congressional appropriation of $142,500 permits the employment of but 29 salaried wardens.

That sentiment favors a stronger governmental support of the measure is evidenced by the action taken by the International Association of Fish, Game and Conservation Commissioners. At its recent meeting in Ottawa, the association adopted a resolution calling for the issuance of federal licenses for hunting migratory birds. Licenses in the form of special stamps to be issued by postmasters and attached to state licenses were recommended. It was estimated that the revenue from such licenses would amount to between $1,000,000 and $2,000,000, an adequate sum to be used for the protection of game.

GOLDEN TROUT.

Golden trout received wide distribution owing to the successful results in the hatching and rearing of golden trout at the Mount Whitney Hatchery in Inyo County. The California Fish and Game Commission has been able to stock many barren streams and lakes in the southern Sierra with golden trout. Until recently the stocking of streams was dependent upon the capturing of golden trout by hook and line and the transportation of the fish thus caught. Now the Mount Whitney Hatchery has an output of nearly one million golden trout annually.

During the past fall, under the direction of Commissioner M. J. Connell of Los Angeles, the golden trout fry from the Mount Whitney Hatchery have received wide distribution. With Deputy E. H. Ober in charge of the pack train, plants have been made in tributaries to the Middle Fork of the San Joaquin, Madera County. Until they received their quota of golden trout these streams were barren of fish life. The plan is to plant desirable streams and to keep the stock pure. Crystal Lake, which was planted in September, 1918, was found this year to be teeming with beautiful fish ranging from five to ten inches in length.

WHY?

Although the Fish and Game Commission has been having splendid success in convicting violators of the fish and game laws, yet their efforts are occasionally handicapped by some judge who fails to make a conviction possible. As evidence, the following may be cited:

Deputy Harrington arrested Mr. H. Zirn of San Pedro for having in his possession 250 pounds of spiny lobsters over the size limit of sixteen inches. Most of these lobsters measured from seventeen to twenty-two and a half inches in length, and were consequently illegal. When the case was tried by one of the San Pedro judges, two of the lobsters properly labeled were presented as evidence, but because these lobsters had been boiled to preserve them, the judge ruled that the evidence had been changed and therefore that the violator could not be ruled guilty.

Why should such unreasonable technicalities be advanced allowing a guilty violator to escape punishment?

FIG. 21. Net 2,400 feet in length confiscated by deputies of the Fish and Game Commission at Richmond Harbor, August 31, 1920.

NETS CONFISCATED.

On August 31, 1920, deputies A. Mack, Bert Leahy and M. S. Clark of the Fish and Game Commission discovered two large "illegally" used nets at the mouth of Richmond Harbor. These nets were confiscated. One was found to be 1800 feet in length and the other 1600 feet, making a total of 2400 feet of net. One of the owners of the nets was captured and paid a fine of $100 in addition to the loss of the nets confiscated.

BOTTOM DROPS OUT OF THE FUR MARKET.

According to a letter written by Funston Brothers and Company of St. Louis, published in the Illinois Sportsman, October 14, 1920, the fur market is still stocked with the bulk of last year's catch and the above named company advocates, therefore, little if any trapping during the coming season. To explain the situation they write as follows:

"One of the principal reasons why the dealer is carrying such an enormous stock is due to the fact that the manufacturing end of the business has had a strike since last May. Ten thousand men have been out, and a great many of them are still out. This has resulted in the fur dealer being compelled to carry the furs all during the manufacturing season, and he still has them on hand with a new fur season coming on."

It is stated that the market price of furs will be reasonable, the fur dealers being willing to sell at a loss, and that

until conditions improve it is advisable that the trapper should not trap and ship furs this season. If they do the prices which they receive will not be remunerative, as financial conditions among the manufacturers are such that the fur dealers will be unable to buy much of the new fur.

Little is said of the conservation side of the question, but in order that the fur-bearing animals marketed should be saved from extravagant waste, it seems even more advisable to discourage the seasonal trapping of the year.

COMMISSION COMPLIMENTED BY BUREAU OFFICIALS.

Lewis Radcliffe and Henry O'Malley of the United States Bureau of Fisheries have recently been making an investigation of the fisheries of California and the conservation work of the state's Department of Commercial Fisheries. These officials appeared very much pleased with the work carried on by the California Commission, and stated that the Bureau of Fisheries appreciated the public spirit of the Commission in maintaining the preservation laboratory at San Pedro until appropriations would allow the Bureau of Fisheries to again support the project.

The Bureau of Fisheries is at present making a thorough investigation of the methods of caring for and preserving fishing gear in which $15,000,000 is now invested in the United States, exclusive of boats. The life of nets and other gear is very short under existing conditions, and other ways and means of increasing the length of time they can be used are being sought.

HUNTING AND ANGLING LICENSES.

There has been a remarkable growth in the number of hunters and anglers in the State of California, as evidenced by the sale of licenses. In 1914 the number of angling licenses totalled about 84,000 and the hunting licenses about 165,000. In 1919, the anglers numbered over 145,000 and the hunters 178,000. According to current compilations of the number of hunting licenses issued in the various states, Pennsylvania, New York, Ohio, Illinois and Wisconsin, in the order named, lead California in the number of hunting licenses sold. In the whole United States there are about 7,000,000 hunters who pay a license fee and it is estimated that over 3,000,000 more are exempted from the fee by various state laws.

DUCKS MOVE TO NEW FEEDING GROUNDS.

The lack of fresh water in the larger streams has greatly increased destruction to pilings by the teredo in or at the mouth of the San Joaquin-Sacramento rivers. Many wharfs along the Carquinez Straits have had to be abandoned and continual repairs are being made on others. Soft-shelled clams which heretofore have been restricted to San Pablo Bay are now thriving in Suisun Bay, with the result that such ducks as the canvasback and the lesser scaup are utilizing the upper bay more largely as a feeding ground.—H. E. F.

HELP SAVE THE WOOD DUCK

The wood duck, said to be the most beautiful duck in the whole world, is protected by federal law, but not all shooters are able to identify the females, or the males in immature plumage. In an attempt to prevent the killing of wood ducks by mistake, the Department of Conservation of Massachusetts has issued a poster giving colored illustrations of the wood duck in flight, showing its different plumages, with the request to "look before you shoot."

The following marks for field indentification are offered:

(1) Any duck with a white breast found near streams or fresh-water meadows in September or early October is almost certainly a wood duck.

(2) Any ducks, which when suddenly startled, fly away without quacking, have the tail longer and the neck shorter than that of the black duck, will probably be wood ducks.

(3) Any duck which can be heard uttering a peculiar note, sounding like "Oo-eek," is a wood duck.

GAME LAWS FOR 1920.

The total number of game laws enacted in 1920 probably will not exceed 60, which is about normal for "even" years, when only a few states hold legislative sessions. In the laws enacted further progress was

made along the line of harmonizing state legislation with the migratory bird treaty act regulations.

The most important changes affecting big game were in New York and Quebec. New York reenacted the buck law and limited the hunter to one buck a season. The deer season was also modified in several localities. In Quebec the season was shortened 19 days on deer and bull moose, except in four counties, and 50 days on caribou.

Legislation of far-reaching importance looking to the preservation of quail and other upland game birds included an act of Congress, approved December 18, 1919, prohibiting the sale of upland game birds in the District of Columbia, and an act in Maryland prohibiting the sale of quail, ruffled grouse, introduced pheasant and wild turkey in that state.

For the convenient use of sportsmen and others the Biological Survey of the United States Department of Agriculture has compiled information resulting from game legislation, and this has been published as Farmers' Bulletin 1138. This contains a summary of federal, state, and provincial laws for 1920; a summary of laws relating to seasons, licenses, limits, sale and export; disposition of game raised in captivity; the text of the Lacey Act regulating interstate commerce in game, and of the tariff act prohibiting importation of plumage; the law protecting birds and their eggs on federal bird reservations; the regulation regarding hunting on national forests; the treaty for the protection of migratory birds; the migratory bird treaty act and the federal and Canadian regulations; text of order of Secretary of Agriculture permitting the killing of reedbirds; a list of officials from whom copies of game laws may be obtained; and a list of the publications of the Department of Agriculture relating to game. Farmers' Bulletin 1138 may be had upon request of the United States Department of Agriculture, Washington, D. C.

WRONG SEASON ON DOVES.

On the opening day of the dove season (1920), the writer and one of his friends went out for a try at the doves. We had to go about two and a half miles to an orchard where we found plenty of the birds. I got thirteen and my friend got eight. He had a twenty-two rifle and I used a shotgun. I could have taken my limit but I waited until I could take two at a shot, making them come at two and a half cents apiece.

As we started to come home we took a longer way back in order that we might shoot some jack rabbits for the dogs. I found three dove nests while hunting for the rabbits and my friend found four. Two of those which I found had eggs in them and one had squabs, almost ready to fly. The nests which my friend found held two eggs each. This seems to me to demonstrate quite clearly that the dove season opened too early.—CHARLES FOLLETT, *Merced, California.*

TWO DEER AT ONE SHOT.

We all hear of the man who discovers himself short of ammunition and uses this as an excuse for his inability to secure a deer, but it is seldom that we hear of a man lucky enough to secure his limit of deer in one shot. The opening day of the season found Fred McKenzie, an employee of the Ukiah post office, together with friends, camped on Baldy Mountain. On the day before leaving this camp, two three-point bucks appeared standing side by side. McKenzie pulled up and shot, the bullet passed through the neck of the first deer and struck the second in the base of the brain.

Although this sounds like the usual hunting story, it has been verified by Fish and Game Deputy B. H. Miller.

FACTS OF CURRENT INTEREST.

A more than ordinary rainfall during the winter months so scattered the ducks that bags have been small.

The comparatively small run of salmon the past year has emphasized the necessity of a careful scientific investigation of the life and habits of this fish, such as is in progress.

The first of the year finds the sardine canneries burdened with a large part of last year's pack. As the price of canned sardines advanced in price but a very small per cent, a reduction in price to move last year's pack means a distinct loss to the canner.

A new State Fisheries Laboratory is under construction at San Pedro. This laboratory will afford facilities for the scientific staff engaged in investigations on the commercial fisheries.

During the past biennial period 1891 arrests for violation of the fish and game laws have been made, and fines totaling $46,373 collected.

State lion hunter Jay Bruce has succeeded in killing thirty mountain lions during the past year. When it is known that this means a saving of at least 1400 deer, it will be seen that the salary outlay for Mr. Bruce is well spent.

A fisherman on the Sacramento River arrested for having illegal nets in his possession was recently sentenced to one hundred days in jail by Judge Quince of Benicia.

HATCHERY NOTES.

W. H. SHEBLEY, Editor

TROUT AND SALMON DISTRIBUTION.

The distribution of trout and salmon fry from the hatcheries and ponds of the Commission was completed November 5. While the number of fry distributed was not as great as last season, the fry were in better condition and the distribution was systematically carried out, so that the results obtained were very gratifying.

With very few exceptions all the shipments were under the supervision of the car messengers and the hatchery employees and the fry were planted in good condition. Some of the shipments were turned over to applicants who have had several years' experience in planting fry and who used their efforts to make the work of distribution in the streams and lakes in which they were interested a success. On the long trips from the railroad stations to the interior districts, there were less fish lost than in any previous season, judging from the reports received from applicants.

There were about eight thousand cans containing sixteen and one-half million trout fry sent out from the hatcheries, by truck and distribution cars and, as far as can be learned, there was only one serious loss during the season and that was caused by the breaking down of a truck. This shipment was turned over to the Forestry officials who sent out a driver without an assistant. This driver neglected the fish during the time that his truck was being repaired and consequently a great many of the fish were lost. Our men on the distribution car were not to blame, as the Forestry officials who have had experience in planting fish were to handle this shipment. Mention is made of this to demonstrate the fact that our system of planting the fry is very successful.

The demand for trout fry was very great this last season owing to the depleted condition of the streams caused by the excessive fishing during the period of low water which has prevailed over the entire state for the last three years. The fish were confined to the larger pools and were easily taken by the anglers. Some of our best trout streams were fished almost to depletion during the period of drought and an increased number of fry will be necessary to restore the streams to normal conditions again as well as a shorter open season, so that the fish will have a chance to grow.

The present season in most of our fish and game districts is open too long to give the fry a chance to grow and mature into breeders. The season should be shortened by the coming legislature, so that the fry will have a chance to grow and give the anglers better sport.

SALMON EGG COLLECTING, FALL OF 1919.

The extremely low water of last fall prevented the salmon from entering the tributary streams of the Sacramento River on which are located the egg-collecting stations of the Bureau of Fisheries. Consequently, the number of eggs collected was very much smaller than usual and all the eggs that the Bureau could spare for our Mount Shasta station was 4,235,000.

The resulting fry were held and fed until late in the spring, when 3,100,000 of them were placed in the large rearing ponds connected with the Mount Shasta Hatchery. Here they made a rapid growth and were released in excellent condition during October in the tributary streams of the headwaters of the Sacramento River.

Twenty thousand of the fry were marked and will be liberated as soon as all danger of fin regeneration is over.

The run of salmon on the Klamath River did not reach our egg-collecting station in as large numbers as we expected as the lack of rain caused them to spawn lower down the river and in some of the small tributary streams miles below our racks.

A large percentage of the breeding salmon that enter the small tributaries of the Klamath River as well as the Sacramento tributaries are taken by persons with spears at a time when they are hardly fit for food. The taking of these fish by persons desiring them for food, when the fish are on the spawning ground is not only destructive to natural propagation, when confined to the number that can be legally taken, but there is a wanton waste of the fish by persons who spear them on the spawning beds and are forced to throw them away when they find them in no condition to use as food. Oftentimes fish are speared until a fish is taken that is considered edible. A large majority of the breeding salmon after they reach the spawning grounds are emaciated and covered with patches of fungus, making them unfit for food.

The take of salmon at Klamathon during the fall of 1919 was 4,974,000 eggs. Of these eggs 3,307,000 were taken to the new Fall Creek Hatchery, located twelve miles above Klamathon on Fall Creek, one of the finest streams of water for the rearing of fish on the coast. The resulting fry were placed in ponds and held until October, when they were liberated in good condition.

Extensive plans were made this fall to take a large number of salmon eggs at our Klamathon Egg-Collecting Station. The Bureau of Fisheries also was prepared to operate its Battle Creek and Mill Creek stations on the Sacramento River to their full capacity. The unusually heavy rainfall during November caused the streams to rise very rapidly and at the height of the salmon run, November 17, the racks at Klamathon were so badly damaged by the high water that the salmon that were ascending the river escaped above the racks and our take of eggs was considerably less than expected.

FIG. 22. Racks in the Klamath River used to capture salmon for spawning purposes. Photograph by L. J. Stinnett.

The racks at Mill Creek and Battle Creek stations of the Bureau of Fisheries were washed out at the height of the salmon run. The loss in eggs that could have been collected from the salmon which escaped above the racks is estimated at between 20,000,000 and 25,000,000, at all stations damaged by the high water. This would not be so serious during normal seasons, as the natural propagation would take place on the spawning beds and a certain percentage of the eggs would hatch, but during periods of torrential floods in the streams frequented by the spawning salmon, the shifting sand

and gravel disturbs and moves the eggs and a great many of them are destroyed or are buried so deep that they cannot possibly hatch out.

The total take on the Klamath River was about 7,000,000 eggs, and from unofficial reports received the number taken by the Bureau of Fisheries was approximately the same.

While the loss in eggs is to be regretted we will be able to give the eggs collected extra care and, in a measure, make up for the shortage of eggs at the hatcheries.

SAN JOAQUIN RIVER SALMON.

The Kerckhoff Dam, property of the San Joaquin Light and Power Company, that has recently been completed, near Aubery's on the San Joaquin, prevents the passage of the salmon to their former breeding grounds on the upper reaches of the river.

The Merced River will no longer afford a spawning ground for salmon, as a large irrigation project is planned that will hold back the flood waters of the Merced in a lake to be made by the construction of a high dam across the river near Exchequer. Plans had been made for the construction of fishways over the small dams in the Merced River, property of the San Joaquin Light and Power Company, and arrangements made for their construction, but the plan of the large irrigation reservoir makes it impracticable to attempt any further efforts to perpetuate the run of salmon in the Merced River. With the completion of the Kerckhoff Dam and the proposed dam at Exchequer, the spawning grounds for salmon on the San Joaquin River and its tributaries are practically all cut off from the breeding salmon. During seasons of normal rainfall a few salmon will probably spawn near Friants, below Power House No. 4 of the San Joaquin Light and Power Company. This area is very small and would not have any effect in keeping up the run of salmon in the river.

An experimental salmon culture station is being established on the San Joaquin River with the object in view of determining what the expense will be of collecting the eggs near Friants in the fall and transporting them to the hatchery on Willow Creek, a distance of about thirty-five miles, hatching the eggs and rearing the fry in ponds, the fry to be held in the ponds until the following fall, then convey them by auto truck to the river below the Kerckhoff Dam.

FIG. 23. Fishway while under construction at the Folsom Dam, on the American River. This fishway, recently completed, is one of the highest and best yet constructed in California. Photograph by A. E. Doney, October 24, 1919.

Two or three important features enter into this undertaking that will be the determining factor as to whether a successful salmon culture station can be established or not on the San Joaquin River. One is the expense of transporting the fry from the ponds to a point below the dams and the other is the screening of the large canals taking water from the San Joaquin River, from Friants to the diversion at the Temple Canal.

The expense on the transportation by auto truck of 2,000,000 or 3,000,000 fry each fall from the rearing ponds to the river below the dam should not stand in the way of keeping up this valuable supply of food fish for the people. A three-ton truck, with two men in charge, could transplant the fish in thirty days.

The river bed from this point to the Kerckhoff Dam, which diverts the water through a 17,000-foot tunnel, is dry during the summer and fall, as all the water is used for the operation of the power house. Under present conditions all the salmon that ascend past this point on the river, during the spring when the river is high, will pass the power house and lie in the pools between the power house and the dam for a distance of approximately fourteen miles. These will perish during the summer and fall when all the water of the river is diverted through the tunnel for power purposes. These fish cannot be saved at present, and very few are taken for food as the river from the dam to the power house flows through an almost impassable gorge, where few persons ever enter. If the plan of hatching the eggs at Willow Creek proves a success, racks will have to be placed across the river below the power house and the fish prevented from passing into the gorge.

There is a project started that will probably be completed during the next year or two, which consists of a high dam across the San Joaquin River at Friants to hold back the flood waters of the San Joaquin River for irrigation purposes. If this project goes through there will be no necessity for the racks as the salmon can be taken at the dam during the fall and their eggs collected and taken to the hatchery.

All of the above conditions must be carefully investigated and if it is practicable, plans must be made to save this valuable run of salmon on the San Joaquin River.

SALMON IN THE EEL RIVER.

The commercial fishing at the mouth of the Eel River and the spearing of the breeding salmon on the riffles on the upper reaches of the river necessitated the propagation of salmon in larger numbers on Eel River. Experimental work was carried on at an experimental station on Buli Creek, one of the tributaries of the South Fork of the Eel River and also in the main river near the mouth. The results of these experiments of the last three years have not justified the expense of establishing a permanent egg-collecting station on the lower reaches of the river.

There are several conditions on the lower reaches of the river that in our judgment makes it impracticable to establish an egg-collecting station in that region. The salmon when they enter the mouth of the river are compelled to remain in the large pond below Loleta until the river rises in the fall, as there is not enough water during the seasons of normal rainfall to allow the fish to pass over the wide, shallow riffles connecting the large pools from South Fork to the large pool at the mouth of the river.

As a rule the river rises to a considerable extent, but not before the majority of the salmon are caught by the commercial fishermen at the mouth of the river in the large pool. It has been suggested that eggs be collected from the fish in the large pool during the early fall before they ascend the river or are taken by the commercial fishermen but we find that the fish do not ripen in numbers great enough to justify the expense of seining them up and separating the few ripe ones from those that are green or immature. Furthermore, there is no water near the mouth of the river suitable for hatchery purposes. If eggs could be taken in sufficient quantities to justify the expense of collecting them they would have to be taken direct to Fort Seward Hatchery on the railroad, some sixty miles up the

river. The eggs collected would in all probability be in such small lots that it would not pay to keep the necessary help and equipment.

Any attempt to place racks across the main Eel River or the South Fork, anywhere near its mouth, is almost impossible as the loose nature of the formation is not solid enough to hold the racks and, even if this were overcome, the tremendous amount of water that comes down Eel River during flood periods, carrying logs and debris of all kinds would make it impossible to retain any kind of a rack in the river. Furthermore, if a rack could be built that would stand the flood water of the river when the salmon were running, the number of fish that would be entering the river would be all fresh run from the ocean and would have to be held too long in order to have them mature.

An egg-collecting station on Eel River or its tributaries must be situated far up the stream, away from the tremendous floods and the floatage matter in the river, and must be in the upper reaches near the spawning grounds, where the fish have spent the necessary time in fresh water for the breeders to mature.

A careful examination has been made of the Eel River and its tributaries for a suitable site and an experimental station has been located near Branscomb on the South Fork of the Eel River in Mendocino County, about one hundred and twenty-five miles from the mouth of the main river. The material for the racks, trap, cabin and temporary hatchery were ordered with the expectation that the station could be finished this fall in time to catch the salmon run that ascends the South Fork, the principal spawning stream of the Eel River system, but the unusually heavy rainfall during November delayed the hauling of the material and caused the river to rise to such a height that it became impossible to complete the work. Plans are being made to finish the work next season and to carry on the experimental work at this station to determine whether there are enough breeding salmon in this reach of the river to justify the expense of establishing a permanent station at this place to collect eggs for the Fort Seward Hatchery. At this hatchery the eggs can be hatched and the fry reared to a suitable size to stock the Eel River and its tributaries.

It takes less fry to stock Eel River and maintain the run of salmon than any other river on the coast as there are few natural enemies of the young of the salmon to be found in the river. There are few predatory fishes, no diverting canals to carry off the water where fry are lost, or overflow basins, and very few water snakes or other natural enemies. If only a few million eggs can be collected and the resulting fry planted each season the run of salmon in Eel River can be easily maintained provided the fishing at the mouth of the river is regulated as well as the ocean fishing, where large numbers of salmon are taken each season.

In our judgment all net fishing should be prohibited in Eel River, as the salmon supply of that region will not stand for the heavy toll taken in the ocean as well as in the Eel River when the fish enter the fresh water to spawn. A law should be passed prohibiting all fishing in Eel River except by trolling. The steelhead trout would then have a better chance, as a considerable number of the adult fish are taken by the nets. The Eel River should be protected as a fish perserve to furnish both steelhead and salmon eggs for propagation.

Every precaution should be used by the Commission to prevent the introduction of any predaceous fish into the waters of Eel River as the stream is one of the few that can be depended on to furnish a large supply of steelhead as well as salmon eggs, if properly protected against too great a drain by commercial fishermen.

The commercial fisheries are increasing off the coast each season and the number of salmon taken in the ocean must surely lessen the number that enter the river to breed. As fish are in prime condition when taken from the salt water, fishing in the ocean should be allowed, but a restriction on the number that can be taken should be made. On the other hand, all net fishing in the Eel River should be prohibited.

COMMERCIAL FISHERY NOTES.

N. B. Scofield, Editor.

SOME CONSIDERATIONS CONCERNING THE SALTING OF FISH.

Mr. Donald K. Tressler of the Division of Fishery Industries, U. S. Bureau of Fisheries, has recently carried on some very interesting experiments on the salting of fish.* Mr. Tressler's work has to do chiefly with the fishes of New England and the Eastern coast, but a study of his work might be of benefit to the packers of the Pacific coast.

Previous to this time very little work had been done on this phase of the fishing industry. It required the stimulus of the enormous demand for food caused by the war to arouse an interest in fish salting and a demand for better methods. The purpose of these experiments was to work out, if possible, a method of salting fish applicable in warmer climates, 70 degrees Fahrenheit and above.

The standards of quality differ from place to place, some localities demanding a hard, dry, salted fish, while others want a white, colorless fish with a softer meat. Two methods of salting are now in common use on the Eastern coast, the dry or "tight packed" method and the brine or pickle method. The former method is almost universally used in the south and the other method in the north.

From a study of the procedure followed at the various places on the Atlantic Coast where fish are salted it would seem that there are perhaps three general methods of applying salt to the fish: (1) the fish are immersed in a solution of salt which is kept saturated, or nearly so, by the addition of salt from day to day; (2) the fish are packed in water-tight containers with dry salt and are allowed to develop their own pickle;

*Some considerations concerning the salting of fish. By Donald K. Tressler, U. S. Bur. Fisheries, Doc. 881 (1920), pp. 1-55.

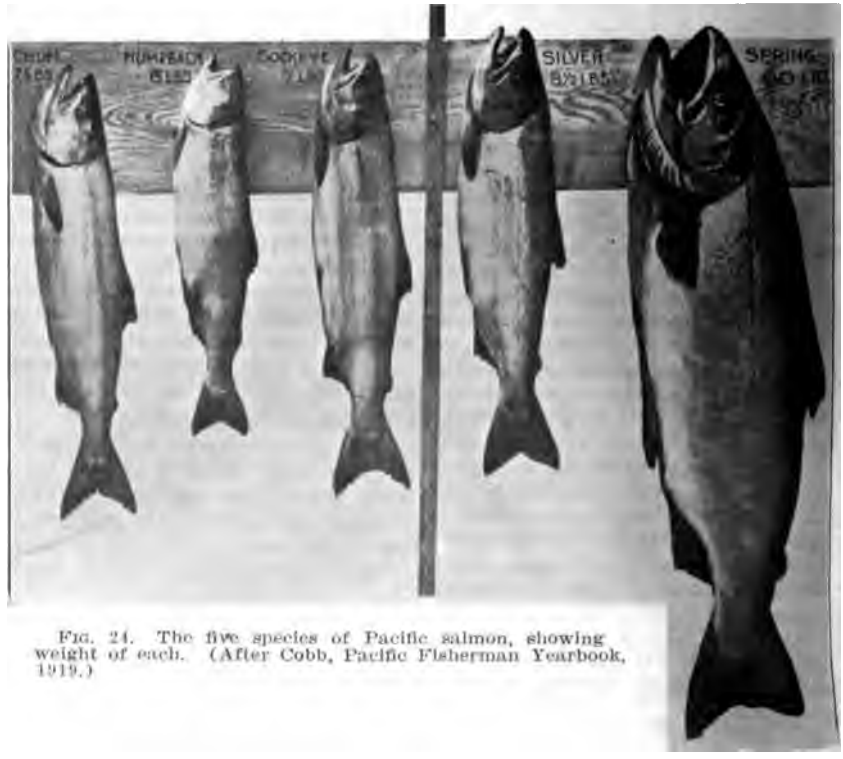

Fig. 24. The five species of Pacific salmon, showing weight of each. (After Cobb, Pacific Fisherman Yearbook, 1919.)

(3) the fish are packed in piles and the pickle allowed to run off the fish as it is formed. This last way is only used in cold weather in an emergency when no containers are at hand.

In storing of salt fish, these general methods are in use: (1) brine; (2) dry, with salt; (3) dry, with boracic acid. In case the first one is used, if the pickle becomes dirty, fresh pickle (salt solution) is added. New brine is always added if the fish are to be stored where it is not cool. If the fish are packed dry they are either sprinkled with dry salt or salt containing four-tenths per cent boracic acid. In all cases the fish must be kept at low temperature if stored for any length of time or they are very likely to "rust." "Rusting" is due to oxidation of the fish oil, giving the fish a dark-brown color. Packing in brine prevents this to a large extent.

Mr. Tressler has found that the impurities in salt exert a great influence on properties of the salted fish as to hardness, whiteness, etc. Pure salt is pure sodium chloride, but there are no salts on the market that are 100 per cent pure. Most American salt is of great purity. Calcium and magnesium salts and sulphates as impurities in salt retard the penetration of the salt into the fish. The investigator also found the following things to be true: That fish packed in dry salt, without the addition of brine, may be kept at a higher temperature than fish salted in brine; the removal of all blood and viscera, including milt and roe, is absolutely essential for the salting of fish at high temperatures; and that during warm weather freshness of fish is essential to successful salting.

From the results obtained by Mr. Tressler, it seems very probable that fresh fish may be salted in any climate of the United States if the following precautions are taken:

1. All viscera and blood must be removed in cleaning.
2. Large fish must be split.
3. Fish must be salted in reasonably fresh condition.
4. No brine should be added in salting.
5. Salts low in calcium must be used.

—A. W. WELLS, *Bureau of Fisheries Preservation Laboratory.*

FIG. 25. Seining for salmon on the Sacramento River near William's Bar. Photograph by R. B. Heacock, April, 1916.

SALMON CONSERVATION AND SALMON TROLLING.

The commercial method of catching salmon by trolling is described in an article by W. L. Scofield in this issue. The catching of salmon by this method has now become an industry of great importance to this state, Oregon, Washington and Alaska. The principal trolling districts in this state are in Monterey

Bay, off San Francisco and near Fort Bragg, Mendocino County. At each of these places about five hundred boats were employed this year. Before sea trolling became important in California salmon were nearly all caught by means of nets in the rivers which they enter at maturity for the purpose of spawning. To show the catch by these two methods we give the following from an article on "Ocean and Stream Salmon Catches," in the October issue of this magazine:

Total Yearly Salmon Catch of the State in Round Numbers.

	River caught	Ocean caught	Season total
1919	5,987,000	7,158,000	13,145,000
1918	7,173,000	5,920,000	13,093,000
1917	5,493,000	5,563,000	11,056,000
1916	5,342,000	5,501,000	10,843,000

The salmon caught in Monterey Bay, off San Francisco and in the Sacramento River are generally classed together as a unit under the assumption that they are the product of the Sacramento River. The following table shows the catch by trolling in these two outside regions contrasted with the catch by nets in the river:

	Monterey Bay	Outside San Francisco Bay
1919	2,816,000	1,443,000
1918	2,893,000	1,929,000
1917	3,880,000	1,280,000
1916	5,231,000	263,000

	Troll fish	Sacramento River
1919	4,259,000	4,529,000
1918	4,822,000	5,938,000
1917	5,160,000	3,971,000
1916	5,494,000	3,451,000

It will be seen that the Monterey Bay catch has been falling off. Contrasted with this is the catch in the Fort Bragg region which has steadily increased due

Fig. 26. The Monterey salmon fleet of fifteen years ago is now entirely replaced with power boats.

to the recent development of the industry at that point. The catch near Fort Bragg was less than half a million pounds in 1917, in 1918 it exceeded one million pounds, in 1919 it was a little less than three million pounds, and this year the catch exceeded three million pounds.

This catching of the salmon in the open sea has added greatly to the difficulties of conserving these valuable fish. Our state laws provide for closed seasons on all of our salmon streams during which time salmon may not be caught. These closed seasons were mostly established before the development of sea trolling and were designed to allow at least one-third of the fish to pass up the rivers to the spawning beds unhindered by nets, under the belief that if this portion of the run, together with the number which escape the nets during the open season, could reach the spawning beds the run would be maintained. If these closed seasons let just enough salmon reach the spawning beds for the perpetuation of the species, then the additional catching of the fish by trolling in the sea before they enter the rivers will be subjecting them to just that much overfishing, for if one-half of the run, we will say, is caught in the sea before it enters the river, the river closed season, instead of protecting one-third of the run as intended, protects only one-sixth of it. It is our belief that the closed seasons on the Sacramento River were not sufficient for the purposes of propagation even before sea trolling came into general practice. The fall season, instead of closing before the latter third of the run has entered the upper bays, does not close until after the last salmon are well up the river and no portion of the run escapes running the gauntlet of nets. This insufficient closed season, coupled with the increase of trolling at Monterey and off San Francisco, has resulted in a decrease in abundance of the Sacramento salmon. This decrease in abundance is shown in the fact that the number of salmon which reach the egg-collecting stations of the United States Bureau of Fisheries on the upper Sacramento River averages less than one-half that of a few years ago. At the same time, in spite of more energetic fishing, the commercial catch has not increased, even if we consider all the salmon caught in Monterey Bay and off San Francisco as Sacramento fish. There is no question but that the Sacramento salmon need decidedly more protection if we are to save these fish from destruction. This need of added protection has been increased by a decision of the Superior Court of Contra Costa County which permits fishermen to net salmon on Suisun Bay and the lower Sacramento River during the summer closed season of June and July; and also by irrigation and power dams under construction and to be built which will shut off important salmon-spawning grounds lying above them.

Fishermen who fish with nets on the bays and rivers think that the sea trolling should be stopped or radically restricted, contending that the trollers are destroying the salmon by catching large numbers of immature fish. Salmon trollers, on the other hand, contend that the sea is the proper place to catch them and that after they have entered the river for the purpose of spawning they should not be caught. There is considerable merit to the arguments on both sides of this question. We are convinced that both methods of fishing need to be radically restricted, and that the time is now here when the laws should be made so as to best conserve the salmon and should not be compromised to suit different factions of fishermen on the plea that the state owes them a living. Salmon on the Sacramento need far more protection than they are getting under the present law, even if sea trolling is greatly restricted. Netting of salmon should not be permitted above the city of Sacramento, the summer closed season of June and July should be restored, and the fall closed season should close two weeks earlier.

It is true that a great many of the salmon caught by trolling are immature as is well shown in the paper on the "Relative Maturity of Salmon Caught by Trolling," in this issue, by Willis Rich. From investigations which have been made it is not clear that trolling is a more destructive method of fishing than is netting in the river. There are evidences which indicate that a salmon fishery may produce more pounds without depleting the supply if the fishing is carried on only in the sea. It is our belief,

however, that until our investigations throw more light on this subject, closed seasons should be established in the trolling districts during those times of the year when the majority of the immature fish are caught. These restrictions should not be so severe as to discourage the development of our sea fisheries, for the future expansion of our fisheries must be through sea fishing as our inland fisheries are now being taxed to their utmost capacity. Sea trolling for salmon, we believe, should be encouraged, for it is the most promising avenue through which sea fishing for other varieties of fish may be developed in the northern half of the state. The inauguration of salmon trolling a few years ago near Fort Bragg has resulted in fishing for other varieties of fish and it can be confidently predicted that within a few years we will have other fisheries there of more importance than the salmon.

EEL RIVER PROBLEMS

Just as the catching of salmon of the sea has been an added drain on the Sacramento salmon, so is the recent rapid growth of salmon trolling near Fort Bragg an added drain on the Eel River salmon, and fish of that river are in need of additional protection. This ocean catch is apparently having little effect on the run in the Klamath River, which is more than one hundred miles to the north.

It seems impossible to devise an open season for nets on Eel River which will satisfy the needs of the sportsmen, the commercial fishermen and the salmon culturist, and at the same time properly conserve the two species of salmon and the steelheads which spawn in the river. The Quinnat salmon begin entering the river early in September, and as there is rarely sufficient water before November to permit them to get above the pools near the mouth, these fish remain there in the fresh water and after a time become of little value for food, although they are still of value for propagation purposes. If the netting season is opened early and closed early so as to let the latter part of the run ascend the river unhindered to the spawning beds, and so as to take these early salmon while they are still fit for food, it meets with the violent opposition of the sportsmen, who contend that it would ruin their steelhead fishing which is carried on in the lower river before the winter rains. If the open season for nets is moved to a time sufficiently late to permit these salmon lying in the pools to ascend the river beyond the reach of the nets, too many spawning steelheads and silver salmon, which begin entering the river about the first of November, would be taken. The present netting season of October 8 to December 7, inclusive, was a compromise season designed to meet the conservation requirements of the two species of salmon and the steelhead, and to partially satisfy the sportsmen and commercial fishermen. This open season has not satisfied the sportsmen or the commercial fisherman, and it has not met the needs of the salmon culturists; and, on account of the development of outside trolling, it does not meet the conservation needs of the Quinnat salmon.

The season is not sufficiently early to take the first part of the run before the fish become inferior for food purposes and it closes too late to let a sufficient number of fish reach the spawning beds up the river. On account of the depletion of the Sacramento run, salmon eggs can no longer be taken from that river to be used in stocking Eel River. If salmon culture is to be carried on in Eel River, the river must furnish its own eggs. Salmon racks can not be maintained in those parts of the river which are suitable for taking salmon for propagation purposes after the river is in flood, and it appears that the only feasible way in which eggs can be taken for this purpose is to permit the first of the run to ascend to the salmon racks after the first rise in the river, which is usually not sufficient to wash out the racks. If the netting season is placed sufficiently late to come after the first rise in the river and closes sufficiently early to avoid taking too many of the late running silver salmon—which date should not be later than December 1—the season would hardly be long enough to make netting profitable. We see no good way of harmonizing these varied interests. Whatever is done it should be seen to that the conservation needs of the three species of fish involved get first consideration.

NOTES FROM THE STATE FISHERIES LABORATORY.*

WILL F. THOMPSON, Editor.

CHANGES IN THE PERSONNEL.

Since the appearance of the last number of this magazine there have been several changes in the staff engaged in fisheries research.

Mr. John W. Rich, who has acted as field assistant in the albacore work at San Diego and San Pedro during the summer of 1920, has returned to Pomona College to resume his studies.

Mr. O. E. Sette, who has been with the Commission for more than a year, has also returned to his college work, having left for Stanford on September 1. He was stationed at Monterey observing the sardine fishery during the fall and winter fishing seasons, leaving there to act as field assistant at San Pedro in the work on the albacore during the summer months. At Stanford he will take up the study of subjects bearing on fisheries research and will at the same time prepare for publication the sardine data which he has collected. The Commission is fortunate in being able to retain the interest and services of Mr. Sette, whose work has been of high order.

To take the places of Mr. Sette and Mr. Rich, Mr. W. L. Scofield and Mr. Harlan B. Holmes have been added to the personnel of the laboratory. Mr. Scofield had been previously employed in research on the salmon and has been transferred to that on the sardine. He will be stationed at the Hopkins Marine Station in Monterey during the coming season, to carry forward the work already done by Mr. Sette. He is known to the readers of CALIFORNIA FISH AND GAME for several contributions made in past issues. Mr. Holmes has been a student at the University of Oregon, at Eugene; comes highly recommended, and with good training in biological work. He will be stationed at San Pedro, and will be engaged in the sardine work in company with Mr. Higgins.

Mr. Thompson will remain in general charge of the work, with temporary headquarters at Monterey. Mr. Higgins will remain at San Pedro.

Professor Weymouth, who has been engaged for several months in research on the Pismo clam, leaves on December 15 for Stanford University, where he will resume his teaching in physiology. He has one paper now in the hands of the printer and another in the process of writing. His work on the Pismo clam will prove of considerable value because of the great interest taken by the public in the preservation of that species, and because his work will prove of fundamental importance in the study of other mollusks.

THE SARDINE SEASON.

The sardine season opens inauspiciously this year, and it seems to be a serious question whether enough material will be obtained to complete our program of investigation for this year. No sardines were being taken at San Pedro at the time this note was written—December 8—and there was little hope held out by the cannerymen that very extensive packing would be resumed at any near date. At Monterey a number of the canneries have ceased operations, but up to the present at least no difficulty has been experienced in obtaining sufficient fish for our purposes.

What will happen in the future is not at present clear. There is no lack of fish at Monterey, and there is no reason to believe that they would be lacking at San Pedro if sought for. The reasons for the failure of the canneries to operate are given as a lack of orders, due very largely to the slump in export trade, and to the expectation of a falling market for sardines.

The sardine investigation, however, will not suffer vitally, even though the program for this year be disrupted, as there are enough data on hand to take considerable time in handling and interpreting. This program has been dealt with in the last issue of CALIFORNIA FISH AND GAME (Volume 6, No. 4, page 180).

*California State Fisheries Laboratory, Contribution No. 23.

CONFERENCES ON THE SARDINE WORK.

In order that the various assistants engaged in work on the sardine may thoroughly understand the program, we have instituted a system of conferences, in which the men engaged at Monterey and San Pedro meet as often as necessary, or more often if possible. The last conference was on the twenty-sixth and twenty-seventh of November, when Mr. Thompson, Mr. Weymouth, Mr. Sette, Mr. W. L. Scofield and Mr. Holmes were present. The purpose in this as on preceding occasions was to correlate the programs and to give everyone a thorough knowledge of them.

These conferences are inevitable because of the necessity we are under of educating the new assistants as they come, and of giving them an understanding of the fundamental reasons for the program we have adopted, if for no other cause. It is our hope that these assistants will be able– after the lapse of several years—to each take over entirely certain phases of the sardine or other problems, and to do this a thorough schooling is necessary. It has become obvious that a merely mechanical execution of duties by a more or less disinterested subordinate will not solve any of our fishery problems, and therefore we hope to give each worker a show in the rewards and penalties which come to the research man.

The inevitable period of training must include work under the senior assistants, but as fast as it is possible to place every investigator on a separate problem to make his own report this will be done, for it is recognized that no man works as well for another as for himself, and that there is no incentive comparable to that of professional success for which full credit is received. But until a thorough knowledge of the fundamentals is obtained such a course would be disastrous to any assistant, and hence the necessity of education.

The more immediate aim is, however, to have a discussion of all that bears on our problems and to make sure that the investigations at Monterey and San Pedro supplement and parallel each other where necessary. These conferences already held have proved of the utmost value in formulating the programs of work, avoiding mistakes, and bringing to everyone's attention the observations made.—W. F. T.

THE PROGRESS OF THE NEW LABORATORY.

The building of the new laboratory at San Pedro has been definitely decided upon by the Commissioners, and the State Architect, Mr. McDougall, has the matter in hand. It is sincerely to be hoped that the building will be rushed, as we will face an embarrassing situation in the near future when the sardines begin to be taken at San Pedro, in that we will have to ask quarters from some cannery for our operations, the temperary laboratory being too far removed.

To those interested in the purposes of the new laboratory the statement concerning them in the last issue of CALIFORNIA FISH AND GAME, Volume 6, No. 4, page 177, will be of value.

THE HABITS OF SEA GULLS.

It is not an uncommon thing to have the presence of small fish in quantity regarded as the reason for the presence of great numbers of sea birds, especially sea gulls, at certain localities. Observation at Monterey has shown, however, that the great flocks of sea gulls frequently seen there during the winter occasionally appear on the days following a severe blow or other weather disturbance. This has not been investigated enough, however, to justify a positive statement, yet is highly suggestive in throwing light upon the belief mentioned as to their connection with the presence of young fish. The visits of the great flocks would seem to be due to the rough surf or wind on the outer coasts, when they are not present in both places in numbers during their migration.

That sea gulls are very sensitive to the condition of the water is strongly implied by an observation we have made upon them at Monterey. This observation has been repeated so often by laboratory members working there as to be beyond doubt. The water off such a lee shore as at Monterey is frequently streaked with light and dark areas, the light areas

being smoother and reflecting the sky more perfectly. These smooth light areas are always strictly avoided by the sea gulls (chiefly herring, western and glaucous-winged) for some reason, the flocks of gulls at rest on the water being invariably and sharply limited by the roughened dark water. This distribution of the flocks upon the water is for the purpose of resting, not feeding, and is invariable and exact. It is a most remarkable and strange fact. Whether the rough areas are caused by winds running counter to the currents or otherwise, the choice of such surfaces as resting places indicates unmistakably the sensitiveness of the gulls to the condition of the water, and thus throws some doubt upon the presence of food as the factor determining their presence.—W. F. T.

A FURTHER NOTE ON THE MONTEREY GULLS.

In the April, 1920, number (page 85) of CALIFORNIA FISH AND GAME, in an article on the "Gulls in Monterey Bay," it is pointed out that these birds, although diurnal in habit, were on one occasion observed to be feeding at night on sardines lost overboard while the lighters were being unloaded at the canneries. Such cases of night feeding are evidently not rare, for gulls in great numbers have been noticed recently on two occasions flying about the lighters in search of chance sardines dropped overboard. On one occasion the gulls were flying half an hour before daylight. The usual habit of the gulls is to spend the night on their roosting grounds, supposedly along the coast, and to appear suddenly at the canneries in large numbers with a regularity as to time that suggests an alarm clock, the time being just before daylight and considerably before sunrise. On the mornings when this sudden appearance was timed it was found to vary but a few minutes from the scheduled breakfasting hour for Monterey gulls. On one other occasion gulls were noticed in large numbers at 10.30 p.m. (November 28) in bright moonlight flying about the sardine lighters. Fishermen and cannerymen say that the gulls have learned that the chances for a square meal are good whenever the sardines are being delivered to the cannery, and that it is no uncommon sight on moonlight nights to see hundreds of gulls flying about on the outlook for stray sardines. Just what amount of fish a gull considers to be a square meal is a question. One gull has been observed to swallow four large sardines in rapid succession and then fly off with ease. If the supply of sardines holds out more are swallowed until the bird is so weighted down that he is unable to fly, and must perforce walk or swim away to some quiet spot where the meal may be digested undisturbed. If confronted with the necessity of flying out of danger, the gull must lighten ship by disgorging his meal before taking to the air. Occasionally the sardine fishermen leave a lighter full of fish uncovered and unguarded, in which case gulls gather in the boat and eat until they are helpless. On the return of the fishermen the overloaded gulls allow themselves to be picked up and thrown overboard rather than disgorge away part of the feast. On one such occasion 65 gulls filled to capacity were counted as they were thrown into the air from a lighter and came down with a splash into the water. After a few feeble attempts to rise from the water these contented gulls swam off sedately, all headed for a sheltered stretch of sunny beach.—W. L. S.

LIFE HISTORY NOTES.

OPOSSUM KILLED ON MOUNT HAMILTON.

Last night I killed a porch climber, in the shape of an opossum (*Didelphis virginiana*), here on Mount Hamilton. A few years ago a number of these animals were turned loose, or escaped, near San Jose, and they have since become established in the Santa Clara Valley. I was somewhat surprised, however, to find one at this distance from the original point of importation.

Mount Hamilton is at the summit of the range bounding the Santa Clara Valley on the east, and lies about thirteen miles, in an air line, from San Jose. It is separated from the Santa Clara Valley by two deeply cut watersheds: Halls Valley and Smith Creek. If the species keeps up its present rate of travel, it will be in the San Joaquin Valley within a few years, and from there will doubtless spread rapidly over the state. From the havoc this one created in the grapevine that marked the end of his particular trail, his relatives will not be very welcome guests to the vineyardists and other fruit men of the state.—W. H. WRIGHT, *Mount Hamilton, California.*

THREE MOUNTAIN LION KITTENS CAPTURED.

About September 1, 1920, reports came to the Fish and Game Commission that there were mountain lions in the vicinity of Cathey Ranch, near Jerseydale, Mariposa County. I was sent to hunt the lions. I arrived at Jerseydale on September 10, and learned then that the lions had been heard screaming near the Cathey Ranch.

Never having heard the so-called scream of the mountain lion, and, in fact, having found them to be an invariably silent animal, I was much disappointed with this report. However, I spent two days hunting in the vicinity of Jerseydale without finding any sign of lions.

In the meantime, I telephoned to Ranger Malcolm McLeod and learned that cattle men had reported that they had seen some lion tracks several times on Owl Creek, near Devil's Gulch, eight miles northeast of Jerseydale. On the evening of September 12, I moved my outfit to the Mariposa Ranger's Station and the next day, while Ranger McLeod packed my equipment to camp on Owl Creek, I hunted on the way over to the

FIG. 27. Mountain lion kittens captured by Jay Bruce, state mountain lion hunter, in Mariposa County, September, 1920. Photograph by H. C. Bryant.

camp, then down the ridge on the east side of Owl Creek, and then to the east up Devil's Gulch and back to camp. I found old tracks of a female lion near the mouth of Owl Creek and in Devil's Gulch, but the indications were that the lioness had not been working these for several days.

The next day, September 14, I started to hunt in the country west of Owl's Creek, and about 7 a.m. my dogs picked up the fresh trail of the lioness going east toward Owl Creek. After trailing about half a mile my silent trailer, Ely, who was about two hundred yards in the lead of Ranger, the hound, jumped the lioness, which was indicated by Ely's barking.

The lioness ran down Owl Creek, going north for about a quarter of a mile, then treed in a live oak. I noticed that when Ranger arrived at the place where Ely found the lioness, he became confused for a few moments before straightening out the trail, but I was taking a short cut to where Ely was barking "treed" so that at the time I did not learn the cause of Ranger's confusion.

After shooting the lioness, the first thing that I noticed was that she had just been nursing kittens, as her breasts were still wet.

I skinned the lioness and afterwards back-trailed her tracks over the course that the dogs had chased her. When I reached the place where Ely had found the lioness, I noticed her fresh tracks going on toward Owl Creek and returning again over the same course; this explained why the hound had gotten confused.

The next thing was to find the kittens. After searching the brush and rocks for several minutes without success, and having in mind the track I had noticed going east from here and returning the same way, I decided that the kittens were somewhere farther east. Evidently, while the mother lion was nursing the kittens she heard the hound baying on her trail, about a quarter of a mile away, and left the kittens and back-trailed herself to meet the dog, but she was surprised by the silent dog, who was in the lead of the hound. Then she turned at right angles and led the dogs down the creek and away from the kittens. I now followed her tracks for about five hundred feet east and across Owl Creek to a bluff of rocks, where the dogs scented the kittens, which were hiding in the small holes among the rocks. Two of the kittens were in one place and the other was about twenty-five feet from them in another hole. After considerable trouble I captured the kittens alive, and after taking off my shirt I carried them in it for about a mile to camp. From the camp I carried them in a barley sack for five miles to the Ranger's Station and then from there by auto to the office of the Fish and Game Commission in San Francisco.

The kittens were about six weeks old and were the size of an adult house cat. They weighed about eight pounds each and were twenty-six inches in length from tip to tip.

The home of the lions was on a ledge about seventy-five feet from the water of Owl Creek and near the top of a bluff of rock. This ledge, which was about sixty feet above the base of the bluff, was about five feet wide and extended about thirty feet along the north side and the same approximate distance along the west side of the bluff. Although there was no cave or den large enough to shelter the mother lion, this was apparently the place where the kittens were born and where they had lived until they were captured; as there were numerous beds, both on the north and west sides of the bluff, where the lioness had been lying on the ledge. The dry grass and moss all along the ledge was well worn and trampled, probably by the kittens while playing. The small holes among the loose rocks behind and above the ledge had evidently provided hiding places for the kittens when disturbed.—JAY C. BRUCE, *Oakland, California.*

HOW MANY EGGS DOES A SALMON LAY?

In the course of a study of King Salmon in Klamath River, it became desirable to learn how many eggs the female produces. Thinking that it may be of general interest, a table including the results of an examination of 30 individuals is given, the specimens being selected from a larger number as fairly representing the average.

Klamath salmon are somewhat smaller than those of the Sacramento, and it is

possible that the females produce fewer eggs. In a series of 3350 Klamath salmon the smallest female measured 20 inches and the largest 42. One either smaller or larger is rarely found.

The number of eggs here given were obtained not by actual count, but by weighing the ovaries, counting a small number of eggs, weighing the latter, and then calculating the entire number. Tests demonstrated that the method gave results accurate to 1 to 3 eggs in a 00. Ovaries from the same fish are not usually alike in size, the left being often somewhat larger than the right and containing as many as 200 or 300 more eggs. No very definite relation is seen between size, weight, or age and the number of eggs, although it will be noted that fish in the fifth year are found amongst those having most eggs.

Number of eggs	Length, inches	Weight, pounds	Age
2146	26½	8⅛	4
2700	31	11⅜	4
2745	31½	14¼	4
2847	30½	12¼	4
2879	28½	9¼	4
2949	30¼	13¼	4
3083	31½	15	4
3110	33½	17⅛	4
3200	32½	16½	4
3305	28	10½	4
3403	31	13½	4
3467	32	15	4
3579	27	9½	4
3586	29½	12⅛	4
3614	32½	14	4
3630	32½	15⅜	--
3672	32	13⅜	4
3676	32½	15⅜	4
3731	33	17½	4
3781	32½	14½	4
3886	30¾	13	4
3935	33	15½	5
4009	31½	14	4
4117	37½	26½	5
4192	32½	17½	4
4197	30½	13¼	4
4200	34½	19⅜	5
4300	32½	15⅝	4
4392	34½	16⅜	5
4842	34½	18	5

Average number of eggs per fish, 3572. —J. O. SNYDER, *Stanford University, California.*

FULVOUS TREE-DUCK SHOT NEAR COLUSA.

On October 16, 1920, while shooting ducks seven miles north of Colusa, the writer saw a flock of about twenty birds which came to the pond several times which were to him unknown. One of these birds was shot so that it might be identified, but when examined none of the party were able to name the bird. While discussing the specimen, Fish and Game Deputy Wm. N. Dirks happened by and identified it as a fulvous tree-duck. *Dendrocygna bicolor.* It was in fine plumage and is of particular interest because it is unusual for one to be seen so far north and at so late a date.—A. C. HANSEN, *Birds' Landing, California.*

BLACK FISH NEAR SANTA CATALINA ISLAND.

While doing patrol duty with the "Albacore," on November 18, 1920, I came upon a school of black fish (*Globiocephalus scamoni*) near Santa Catalina Island, about ten miles north of Lone Point. I estimated that there were about one hundred individuals ranging between thirty and forty feet in length. They were going slowly northward. Unfortunately, I was unable to secure a specimen.

This large, porpoise-like mammal was formerly abundant off the coast of lower California and in the Gulf of California, but in more recent years it is not often seen. An oil made from the head of the black fish is highly prized for use in watches and chronometers. This oil is said to improve with age.—H. B. NIDEVER, *San Pedro, California.*

CONSERVATION IN OTHER STATES.

SANCTUARY FOR WILD LIFE DEEDED TO LOUISIANA.

A tract of land embracing 224,000 acres in Louisiana has been set aside as a perpetual bird sanctuary, and secondarily as a refuge for game, thus bringing to fruition the project of Edward Avery McIlhenny.

On November 8, 1920, deeds were signed in the office of the State Conservation Commissioner which gave to the state in fee simple Marsh Island, 79,300 acres in extent, which was purchased and presented by Mrs. Russell Sage; the Grand Chenier tract, 85,000 acres, purchased and presented by the Rockefeller Foundation, and the Ward-McIlhenny tract, 60,000 acres.

Years ago the plan for this reservation was thought out by Mr. McIlhenny, who first discussed the proposition with a friend, Charles Willis Ward. Mr. Ward supported the idea and as a result the Ward-McIlhenny tract was set aside as a wild life refuge. Mr. McIlhenny, encouraged in his plan to secure an adequate sanctuary for native and migratory birds, found a willing helper in Mrs. Sage. Soon afterwards he secured the appropriation from the Rockefeller Foundation and now the reservation is definitely assured to the state.

The Marsh Island tract lies in the Gulf of Mexico, off the coast of Iberia, St. Mary and Vermillion parishes; its eastern shores are famous as migratory bird haunts. The Grand Chenier tract is on the mainland and adjoins the Ward-McIlhenny tract and is close to Marsh Island. The Marsh Island and Grand Chenier tracts have been under the care of Commissioner Alexander of the State of Louisiana for the past six years, and this supervision has been so successful that it was finally decided to turn them over in fee simple to the state, along with the Ward-McIlhenny tract.

In the event of the discovery of any valuable ore or mineral, it is to be removed with the least possible disturbance to the wild life and the profits accrued must be used to further the protection of it, and if more money is made from this source than is needed for its original purpose, it is to be devoted to education or public health in the state.

VERMONT ESTABLISHES SANCTUARY FOR WATERFOWL.

The Vermont Fish and Game Commission has secured an option upon a tract of 900 acres of marsh land at the mouth of the Lamoille River, on Lake Champlain, as a sanctuary for waterfowl in their trips north and south through this much traveled migration route. The area has been investigated as to its properties for feeding the birds by the U. S. Bureau of Biological Survey and is considered ideal. It is expected that enough revenue can be derived from the trapping privileges to pay the salary of a caretaker; for the region abounds in muskrats, skunks, and other fur-bearing animals. This step is the first of its kind taken in any of the northeastern states.—*The Conservationist*, June, 1920.

VALUE OF PENNSYLVANIA'S ANNUAL KILL OF GAME.

The State Game Commissioner of Pennsylvania, John M. Phillips, through the statistics of the State Commission, estimated that there were 6,000,000 pounds of meat bagged as game last year which, at 20 cents a pound, would have a value of $1,200,000. Three thousand buck deer were killed and 472 black bear. Mr. Phillips estimates that next year there will be 4000 deer killed and that the total weight of the game killed, including all smaller game, will be at least 8,000,000 pounds, which, at 20 cents, would be $1,600,000.—*Field and Stream*, September, 1920.

QUEBEC LICENSES FUR DEALERS.

Canada is following the United States in the effort to conserve fur-bearing mammals. Recently, the province of Quebec took over entire control of its fur trade. Fur traders must take out licenses and report monthly all furs bought. The government imposes a small royalty on all skins before they can be stamped, and no unstamped skin may be sold or shipped out of the province on penalty of confiscation and fine. Trapping out of season is to be controlled, for obviously no inspector will stamp a skin which shows evidence of having been taken out of season. All shipments of skins not plainly marked on the outside will be confiscated and the sender fined. Thus, the poacher will be unable to market his illegally taken fur.

AUTOMOBILES CONFISCATED IN WISCONSIN.

The state of Wisconsin has a law which imposes on hunting violators not only a $50 fine, but deprives these men of their guns, hunting licenses and automobiles. The confiscation of the automobile is a drastic and effective step, for it affords a stronger protection to the partridges and prairie chickens, which must be protected against the onslaughts of those who previously have been willing to "take a chance." They are more apt to think now what it will mean if they are caught.

THE SYSTEM OF CONSERVATION IN PENNSYLVANIA.

In an article published in the Bulletin of the American Game Protective Association, Mr. Holland states that the basis of the game protective system adopted by Pennsylvania is a combination of public shooting grounds and game refuges.

The first game preserve was established in Pennsylvania in 1905, and—quoting from Mr. Holland's report—"at the present time the state has twenty-four state game preserves, eighteen being on state owned forest lands and six on leased land that will eventually be owned by the state. These preserves are approximately nine miles in circumference and individually contain from 1700 to 3200 acres. Around each preserve are from 3000 to 7000 acres of land that is public shooting ground, on which any man may go and shoot, provided he complies with the laws of state and nation." According to the state laws, one-half of the total acreage of the state can be utilized in this way.

The game refuges have been placed as near as possible to the centers of population and in the center of state-owned forest lands, which during the open season constitute the public shooting ground. By this method the game is more readily protected when out of season. The preserves can not be mistaken, for a wire stretched waist high surrounds it, and often as many as six refuge posters can be seen from one point along the reserve. Too, fire protection clearings surround each area. The average cost of establishing a refuge is $2,175, and the yearly cost of maintaining the preserves total about $1,174.

Aside from the larger preserves, there are the auxiliary state game preserves, which "are tracts of land, generally of 250 acres or more. They are cared for by the state, but are owned by some individual or a group of several individuals who are willing to donate or lease the land to the state as a game preserve for a period of ten or more years. A part of each tract is posted and cared for by the state and the balance is used for public shooting. These reservations may consist of farm lands. The plan has been found very beneficial where small game such as quail and rabbit are concerned."

The system of protection practiced in Pennsylvania to assure to the sportsmen an abundant supply of game seems to be eminently successful, and by 1921 Pennsylvania plans to have increased the number of her game preserves to forty.

THE PLATFORM ADOPTED BY THE ILLINOIS SPORTSMEN'S LEAGUE.

The annual meeting of the Illinois Sportsmen's League was held at Belleville, Ill., on May 14, 1920, and quoting from the Illinois Sportsman, the official organ of the League, the program which they are to support follows. It will be noted that the organization still maintains that the Federal Migratory Bird Treaty Act does not give the middle West a fair deal so far as duck hunting is concerned:

First—We are for the enactment of just and equitable game and fish laws and the vigorous and impartial enforcement of the same.

Second—We favor a program which will result in a better understanding between the farmer and sportsman.

Third—We feel that the number of game and fish wardens is inadequate and stand for an increase, also insist that efficient service be given at all times.

Fourth—Since the revenue from the sale of hunting and fishing licenses receipts for fines, etc., more than pays the operating expenses of the Illinois Division of Game and Fish, we ask that this surplus be kept intact in a special fund to be used for the conservation of our wild life.

Fifth—We stand for such an increase in game and fish as will furnish legitimate sport for every citizen.

Sixth—We favor the establishment by the state of recreation grounds which will be open to the public at all times

for either hunting, fishing, camping or other outdoor life sports.

Seventh—We will give our support to the Illinois Natural History Survey and State Forester in the preliminary work now being done for the conservation of what is left of our natural forests.

Eighth—We stand for a system of game refuges, and resting places for waterfowl; that is, in case public shooting grounds are obtained by the state, certain portions thereof shall be set apart where game can breed and raise its young without being molested by hunters, following the Pennsylvania plan.

Ninth—We stand for an extension of the fish rescue work now being done by the state, and feel that this could be made much more effective by the purchase or lease of certain lakes to be used for placing the smaller fish taken from the shallow bodies of water. When larger these fish could then be taken out and distributed for stocking purposes.

Tenth—We stand for a reduction in the bag and possession limits on all of our game birds and animals, this to be determined after a free discussion of the subject through the medium of this organization.

Eleventh—We stand for a change in the open season for the taking of our fur-bearing animals, preferably from November 15 to February 15.

Twelfth—We stand for a change in the open season on rabbits, preferably from November 10 to January 31; and in addition thereto believe a possession limit should be fixed. By delaying the opening of the rabbit season and making it the first day of the open season for quail, there is a general feeling among the true sportsmen that many quail will be saved.

Thirteenth—Millions of dollars are being appropriated by the General Assembly at each session for the good of the people, therefore we are of the opinion that the question of establishing state parks should be given some consideration along this line. Next year we propose asking for a liberal appropriation, and request the cooperation of the people in general in obtaining the same.

Fourteenth—We consider roving dogs and cats one of the greatest existing menaces to our wild game animals and birds during the breeding season, therefore we favor the enactment of a law regulating the same.

Fifteenth—We stand for an amendment to the existing laws which will give the state additional powers in dealing with the pollution of the rivers and other streams of our state causing the destruction of our fish.

Sixteenth—The Migratory Bird Treaty Act has been upheld by the United States Supreme Court, therefore, it is the supreme law of the land, so the safe plan is to obey the same; however, we still maintain that the Middle West states are entitled to a late winter season during February and March for the shooting of waterfowl and hope to convince the United States Bureau of Biological Survey that this concession is due the sportsmen of this section of our country.

REPORTS.

VIOLATIONS OF FISH AND GAME LAWS.

July 1, 1920, to September 30, 1920.

Offense	Number of Arrests	Fines Imposed
Game.		
Hunting without license	23	$340 00
Hunting on posted grounds	5	95 00
Deer—closed season—killing or possession	23	805 00
Failure to produce deer horns or skin	11	425 00
Running deer with dogs—closed season	1	25 00
Female deer—spike bucks—fawns—killing or possession	51	2,725 00
Illegal deer hides	2	75 00
Brush rabbits—closed season—killing or possession	19	410 00
Tree squirrels—closed season—killing or possession	2	50 00
Quail—closed season—killing or possession	19	615 00
Doves—closed season—killing or possession	13	385 00
Ducks—closed season—killing or possession	27	925 00
Sage hens—closed season—killing or possesion	1	25 00
Nongame birds—killing or possession	5	110 00
Protected shore birds—killing or possession	4	200 00
Bear—closed season	6	105 00
Night hunting	1	25 00
Total game violations	213	$7,340 00
Fish.		
Angling without license	9	$230 00
Fishing for profit without license	42	430 00
Fishing in restricted waters	2	120 00
Illegal nets in restricted districts	29	600 00
Salmon—Saturday-Sunday fishing—excess daily limit closed season—taking or possession	2	200 00
Striped bass—underweight—excess daily limit and offering for sale closed season	28	505 00
Barracuda—undersized—taking or possession	1	25 00
Trout—excess limit—taking other than by hook and line	5	125 00
Clams—undersized—excess limit—taking or possession	8	250 00
Crabs—undersized—excess limit—taking or possession	7	96 08
Abalones—undersized—bringing to shore detached from shell	11	425 00
Dried shrimps—possession	5	165 00
Total fish violations	149	$3,170 00
Grand total fish and game violations	362	$10,510 00

SEIZURES—FISH AND GAME AND ILLEGALLY USED FISHING APPARATUS,

July 1, 1920, to September 30, 1920.

Game.		Fish.	
Deer meat	1,230 lbs.	Striped bass	1,125 lbs.
Doves	14	Halibut	600 lbs.
Quail	18	Barracuda	886 lbs.
Ducks	71	Salmon	55 lbs.
Rabbits	23	Perch	100 lbs.
Sage hens	2	Trout	12 lbs.
Deer hides	2	Crabs	377
Bear hides	1	Abalones	204
		Pismo clams	117
		Cockle clams	425 lbs.
		Dried shrimps and meal	6,300 lbs.
		Illegal nets	5

Searches.

Illegal fish and game	17

STATEMENT OF EXPENDITURES.

Period July 1, 1920, to October 31, 1920.

Administration:		
Commissioners	$130 18	
Executive officers	8,262 62	
Printing	716 20	
Research and publicity	1,605 58	
Accident and death claims	776 40	
		$11,490 98
Commercial fish culture and conservation:		
Superintendence	$4,836 25	
Inspection and patrol	10,078 33	
Research	11,009 75	
Statistics	3,376 73	
Market fishing license commissions	144 50	
Propagation and distribution of salmon	9,600 12	
		39,045 68
Sporting fish culture and conservation:		
Superintendence	$5,272 57	
Printing	99 05	
Prosecutions and allowances	117 50	
Angling license commissions	5,043 10	
Fish exhibits	4,287 94	
General patrol, pro rata share—		
San Francisco District (40 per cent)	12,883 72	
Los Angeles District (40 per cent)	5,670 59	
Sacramento District (40 per cent)	10,135 44	
Propagation and distribution of trout	71,079 29	
		$114,589 20
Game conservation:		
Printing	$124 26	
Prosecutions and allowances	536 44	
Hunting license commissions	9,630 50	
Mountain lion hunting (and bounties)	2,566 40	
General patrol, pro rata share—		
San Francisco District (60 per cent)	19,222 11	
Los Angeles District (60 per cent)	8,505 93	
Sacramento District (60 per cent)	15,201 59	
		$55,787 23
Tahoe camping ground		402 11
Total expenditures		$221,315 20

CALIFORNIA FRESH FISHERY PRODUCTS, JULY, AUGUST AND SEPTEMBER, 1920.

Compiled by Fish and Game Commission, Department of Commercial Fisheries.

Species of fish	Del Norte, Humboldt	Mendocino, Sonoma, Lake	Marin	Solano, Yolo	Sacramento, San Joaquin	Contra Costa, Alameda	San Francisco, San Mateo	Santa Cruz	Monterey	San Luis Obispo, Santa Barbara, Ventura	Los Angeles	Orange	San Diego	Total	Mexican
Albacore										500	16,227,880	3,697	1,639,498	17,871,575	
Anchovies							78,345		185,767					264,112	
Barracuda	25						8,402	25,559	45,295	62,152	306,971	11,072	369,668	829,139	332,748
Bluefish								54						54	
Boccaccio		5					34,309	73 878	200,721					308,778	
Bonito								324	15	11,310	195,198	249	57,905	264,996	7,581
Carp				312	7,088	267								7,667	
Catfish				1,649	1,946	45								3,540	
Chilipepper							10,338	14,521	720					25,579	
Cultus cod	1,150	41,877	52				137,822	19,845	8,460					209,996	
Flounders		16					6,602	6,500	446	64	642			14,270	
Grayfish			20			759	3,690				5,207		139,225	148,901	
Hake							35,019	625	55					35,699	
Halibut	20,873	86,405	2,428				11,002	1,233	2,731	58,052	64,386	6,033	308,227	661,370	627,989
Hardhead					470									470	
Kingfish							365	5,111	2,607	551	11,025		285	19,944	
Mackerel								9,678	193,614	20,460	462,232	20,027	120,198	826,229	7,142
Mullet												226	1,211	1,437	90
Perch	178						11,254	103	132		3,327	1,919		16,863	
Pike				23	50	6								79	
Pompano							25	118			1,243	21	120	1,527	
Rock bass										1,689	46,844	6,213	32,430	87,176	485
Rockfish	6 472	651	49				285,066	80,200	85,435	9,690	30,059	1,336	125,316	624,274	2,680
Sablefish							72 912	814	21 981					95,157	
Salmon	948,289	2,388,179	3,711	1,200,972	292,895	1,075,496	1,413,002	31.523	26 149					7,380,919	
Sand dabs							76,358	77 230	2,571				470	156,649	
Sardines							29,925	2,333.620	26,283,995		9,278		754,802	29,861,620	
Sculpin											1,951	100		2,051	
Sea bass—black										145	7,671	392	8,736	16,964	6,288
Sea bass—white			16,291				5 560	98.521	5,778	71,898	630,705	5,516	72,178	906,397	158,156
Sea trout							392				554	20		966	
Shad				294	181	508								973	
Shad—buck						380								380	

Shad—roe				4										4	
Sheepshead										603		14	140	757	165
Skates							849	8,062				19		8,930	
Skipjack								63	3		4,218,843	2,514	2,401,095	6,622,548	4,945
Smelt	11,225		9,842				6,744	30,892	90,568	19,018	26,194	11,213	1,204	206,890	671
Sole	286	4		23			851,163	182,914	3,139	1,609	1,628	170		1,040,834	195
Splittail														23	
Striped bass			252	4,171	1,002	40,066	42,290							87,781	
Stingaree			14,000	108									59,121	73,224	
Swordfish											7,877		1,208	9,085	
Tomcod	111						2,909							3,020	
Trout—steelhead	5,900													5,900	
Tuna										410	1,181,572	1,232	3,210,419	4,393,633	200,415
Tuna—bluefin											10 519,962			10,519,962	
Tuna—yellowfin											446,073			446,073	
Turbot			34											34	
Whitefish											90			90	
Yellowtail										287	191,770	1,398	213,659	407,114	31,737
Miscellaneous	303			52	7		3,899	3,735	1,133	7,471	20,967	1,672	425	39,154	
Total fish	995,512	2,517,137	46,679	1,207,603	298,539	1,117,527	3,127,792	3,704,376	27,131,085	265,840	34,622,034	75,033	9,512,525	84,414,662	1,370,537
Crustaceans—															
Crabs, (doz.)	253						20	2	2					286	
Shrimps							309,759							309,759	
Spiny lobsters															22,443
Mollusks—															
Abalones									210,880	103,831				314,711	35,296
Clams—ecckle			217									820		1,037	
Clams—mixed	2,598		3,202											6,100	
Clams—Pismo										94,494				94,494	
Clams—softshell		649	9,120			57,021	11,493							78,286	
Cuttlefish							6,225	1,627	1,747					9,599	
Limpets												7,800		7,800	
Mussels						588				70		9,400		10,458	
Oysters—															
Eastern (No.)			226 336				608 175							924,511	
Native			16,926											16,926	
Squid								26	31,161					31,187	
Miscellaneous—															
Turtles															36,239

All amounts shown in pounds unless otherwise specified.

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CALIFORNIA FISH AND GAME

"CONSERVATION OF WILD LIFE THROUGH EDUCATION"

Volume 7 SACRAMENTO, APRIL, 1921 Number 2

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A BRIEF HISTORY OF THE CALIFORNIA FISH AND GAME COMMISSION.

By HAROLD C. BRYANT.

INTRODUCTION.

The California Fish and Game Commission having completed fifty years of service to the state in the administration and conservation of wild life resources, it seems fitting that a review of the problems of the past and their solution, together with an outline of the distinctive accomplishments of one of the oldest state commissions, be published, to the end that the work of this Commission may be better understood and

appreciated and that future activities may be governed by the successes or failures of the past.

Under the administration of Governor H. H. Haight, the legislature of 1870 established a Board of Fish Commissioners under "An act to provide for the restoration and preservation of fish in the waters of this state." The bill was approved on April 2, 1870, and Messrs. B. B. Redding, S. R. Throckmorton and J. D. Farwell were appointed as commissioners. The former commissioner served the state for more than ten years.

The United States Commission of Fish and Fisheries was not established until a year later. California thus had an organized fish commission nearly a year before the federal government took up similar work. The appropriation of $5,000 was largely used in importing new varieties of fish and in preserving those native fish which were recognized as valuable food fish. It was not until 1878 that the Commission was granted jurisdiction over game as well as fish.

"The first hatchery owned and operated by the state was situated on the grounds of the State University, in Berkeley. The California Acclimatization Society under the supervision of Mr. J. G. Woodbury had been experimenting, and had made several successful hatches of eggs introduced from the eastern states. Mr. Woodbury afterward became an assistant to Dr. Livingston Stone, at the Baird Hatchery, on the McCloud River, in 1872, when the first attempt was made to propagate the quinnat salmon in California.

INTRODUCTION OF FOOD AND GAME FISHES.

"The California Fish Commission during the first decade of its existence introduced into the waters of this state a number of varieties of food and game fishes and the attending results are regarded as being among the greatest achievements in fishculture and acclimatization."*

In the year 1872, an attempt was made to import from eastern states on a special aquarium car the following: black bass, glass-eyed perch, yellow perch, catfish, tautogs, brook trout, salt water eels, lobsters and oysters. Unfortunately, this large shipment never reached California owing to a train wreck which was described in the official report as follows:

"After leaving Omaha we stowed away as well as we could the immense amount of ice we had on the car, and having regulated the temperature of all the tanks, and aerated the water all round, we made our tea and were sitting down to dinner, when suddenly there came a terrible crash, and tanks, ice, and everything in the car seemed to strike us in every direction. We were, every one of us, at once wedged in by the heavy weights upon us, so that we could not move or stir. A moment after, the car began to fill rapidly with water, the heavy weights upon us began to loosen, and, in some unaccountable way, we were washed out into the river. Swimming around our car, we climbed up on one end of it, which was still out of water, and looked around to see where we were. We found our car detached from the train, both couplings having parted. The tender was out of sight, and the upper end of our car resting on it. The engine was three-fourths under water, and one man in the engine

*Shebley, W. H.: History of the Introduction of Food and Game Fishes into the Waters of California. California Blue Book, 1911, pages 513–527.

cab crushed to death. Two men were floating down the swift current in a drowning condition, and the balance of the train still stood on the track, with the forward car within a very few inches of the water's edge. The Westinghouse air-brake had saved the train. If we had been without it, the destruction would have been fearful.

"One look was sufficient to show that the contents of the aquarium car were a total loss. No care or labor had been spared in bringing the fish to this point, and now, almost on the verge of success, everything was lost." (Bienn. Rept. Fish Comm., 1872-1873.)

Undiscouraged by this loss the Commission asked Mr. Stone, who was in charge of the aquarium car, to return East and obtain a new shipment. With the help of the United States Bureau of Fisheries, 40,000 shad were secured in the Hudson River. These fish arrived safely and were planted in the Sacramento River at Tehama.

FIG. 28. Fisherman unloading catch of shad. Over a million and a half pounds of shad are taken annually in California. They were first introduced into the waters of the state by the State Fish Commission in 1871 and a second plant was made in 1873.

In the fall of 1872, a shipment of white fish eggs was secured in the East. These were hatched with success and 25,000 young white fish were planted in Clear Lake. During this period, Tahoe trout were introduced into several coastal lakes and streams. This constituted the first transplantation experiments.

On June 12, 1874, another importation which included black bass, glass-eyed perch, Schuylkill catfish, horn-pouts, silver eels, eastern salmon, rock bass, tautogs, lobsters and salt water eels, were distributed to different lakes and streams of the state. The tautogs were placed in San Francisco Bay and the white fish in Tulare Lake.

During the years 1876–1877 an attempt was made to acclimatize the awa, a fish from Hawaii. Apparently, there were no results from the

plant made near Bridgeport, Solano County. Efforts to better establish the white fish, shad, and other fishes were continued and additional importations were made. The striped bass was introduced in 1879 and the carp in 1880.

The first published report on the edible fishes of the Pacific Coast appeared in 1881.

In 1898, six fish hatcheries were in operation, as well as several egg-collecting stations, and the Sisson Hatchery had been enlarged to handle 16,000,000 eggs at one time.

In 1903–1904 additional attempts were made to introduce the greyling and the land-locked salmon. Although fish were planted, no results were obtained. At the same time four dozen elegant quail imported from Mexico were liberated, but soon disappeared. Chinese quail were the subject of still another acclimatization failure.

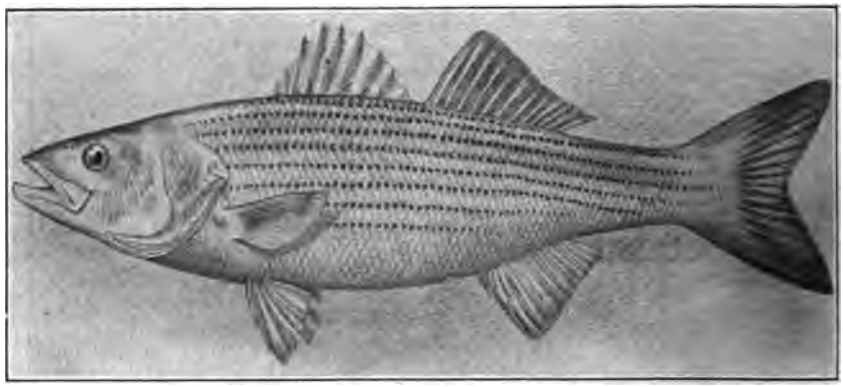

FIG. 29. Striped bass, *Roccus lineatus*, the successful introduction of which was accomplished in the year 1879, when 135 were planted near Martinez. A second plant was made in June, 1882, when about 300 were planted in Suisun Bay. The increase has been remarkable.

Continued interest in the introduction of new food fishes led to the importation and planting in 1908 of crappie, blue-gilled sunfish, yellow perch and ring perch, making about thirty different exotic species given a trial in the waters of the state. The above species have increased and are well established in the Sacramento and San Joaquin rivers. Attempted introduction of the ayu from Japan in 1920 met with failure.

Enthusiasm over the golden trout of the southern High Sierra led to many transplantations of this fish beginning in 1909 and 1910. As a result this species is now found 150 miles to the north of its original home in the head waters of the Kern River.

Transplantations of striped bass were also attempted in more recent years.

OUTSTANDING PROBLEMS AND ACHIEVEMENTS.

The first outstanding problem confronting the Commission was that of the pollution of coastal streams by sawdust from the mills. It was found that the fish life in those streams into which the refuse from mills was poured soon became barren and demand was made for legislation to prevent further pollution.

The need for fishways was apparent to the first board appointed and within a few years the building of them was made compulsory. The following quotation from the 1870–71 Biennial Report is of interest:

"At one dam on a tributary of the Truckee a mill owner consented to put in a fishway, at the earnest solicitation of one of the commissioners, and to prevent the expenses of a suit. He said the law was an infringement of his rights, and when the legislature passed an act to compel him to spend money in such foolish business they should have appointed a schoolmaster to teach the trout how to use the contrivance; he did not believe a fish could be coaxed to go near it. The next evening after the fishway was placed in position the fish were passing it every few minutes; the mill owner became a convert to the practical use of fishways. He soon tore away the cheap and temporary affair built to comply with the law under compulsion, and has erected in its place a substantial ladder that will last for years."

FIG. 30. Chinese shrimp fishermen and small fish, caught in the shrimp nets, being dried. The danger to young fish as a result of the shrimp fisheries early became an important problem of the Fish and Game Commission. Photographs by N. B. Scofield.

The most important problem confronting the Commission in the years 1876 and 1877 was the decreasing run of salmon in the Sacramento and San Joaquin rivers. A demand for a closed season to limit the catch was made as a result of investigation. Interest in the salmon situation continued for several years and statistics on canning operations and output were secured.

Decimation of immature fish as a result of the practices of the Chinese shrimp fishermen, and the destruction of the sturgeon by the use of Chinese set lines next attracted the attention of the Commission and in 1885 a strengthening of the patrol service was ordered as was also the building of a patrol launch. By this time shad had become so numerous that a repeal of the closed season was recommended. Interest in salmon centered around the complaint that sea lions destroyed large numbers as they entered the Bay, and the building of the first large state salmon hatchery which was located on Hat Creek.

An interesting political situation hindered the work of the Board during the years 1886 and 1888: "The work of the Commission was progressing very satisfactorily, until disturbed by the attempt on your part (the report was made to Hon. R. W. Waterman, then Governor of

the State of California) to reorganize the Commission by placing thereon persons of your own selection. This attempted removal of the members of the Commission (Routier and Harvey) discredited the acts of the Commission, destroyed public confidence in the legality of their official acts, and defeated all efforts to an efficient discharge of their duties. That the legal status of the Board might be determined, Mr. J. D. Redding, who had been appointed by you to succeed Commissioner Routier, obtained the permission of the Attorney General to bring an action in the name of the people to oust Mr. Routier, but after suffering the action to remain in the courts for several months, he caused it to be dismissed. Subsequently, the State Board of Examiners, moved by the clamor of claimants who had furnished supplies, or rendered services to the state, agreed that the question as to who were entitled to act as the

FIG. 31. A view of the Mount Shasta Hatchery taken about the year 1905. There are now six large hatchery buildings on the grounds.

State Board of Fish Commissioners should be submitted to the Attorney General, and that the opinion of that officer should be binding upon the Board of Examiners until overruled by the courts."*

The licensing of market fishermen as a means of controlling the salmon situation was begun on March 21, 1887.

Although appointed solely in the interest of preserving and increasing a fish supply, the Fish Commission early recognized the need for conserving game, notably deer, as is evidenced by the following excerpt:

"We recommend that the killing of deer be prohibited absolutely for the next two years, and also the having in possession of the skin of any deer for the same time. This is rendered necessary because of the great

*Biennial Report of the State Board of Fish Commissioners of the State of California, for the years 1886–1888.

loss of these animals during the extremely severe weather of the last two winters, as well as their indiscriminate slaughter in some localities by hunters who defy the law with impunity. With these men, nothing save the heavy hand of the law can be made effective." (Biennial Report 1888–1890.)

An appropriation of $2,000 first gave the impetus to the introduction of foreign game birds. In 1889 attempts were made to secure Oregon pheasants but actual stocking of the state did not begin until several years later.

The screening of irrigation ditches now attracted attention for the first time and steps were taken to improve the existing situation. It was at this time also that various conflicting county laws relative to the mesh of salmon nets made the enforcement of the salmon laws very difficult.

The sale of fish and game in San Francisco during the closed season became an important problem in the years 1891 and 1892. Under a system of cold storage it was possible for markets to hold fish and game, taken at a time when it was lawful, and to sell it during the closed season. It became apparent that unless some limitations were imposed the closed seasons for fish and game would cease to accomplish any purpose, and recommendations were made accordingly. Demand was also made for an investigation of the marine fishes and the spawning and hatching of the same.

By 1893, with an appropriation of about $20,000 and an income from fishermen's licenses of about $4,000, the Commission was able to employ an attorney, and twenty-seven deputies who served without pay. Furthermore, the first compilation of the game laws of the state was made and printed. Sportsmen's clubs which had by this time begun to appear were encouraged.

Of particular interest were the game statistics secured and published in the 1895–1896 Biennial Report. A table shows the receipts of game birds in the San Francisco and Los Angeles markets. The totals show 332,630 pounds of ducks, 175,444 pounds of geese and 37,880 pounds of California doves, pigeons and other game birds. The total valuation of the birds in the San Francisco and Los Angeles markets was $62,362.01.

In 1897, attention was again directed toward the introduction of ring-necked pheasants and 323 were purchased in Oregon and liberated in five-pair lots. Satisfactory increase was reported. A year or two later about 250 more pheasants were purchased in Hongkong for seventy-five cents each and liberated in several different places in the state.

Interest in commercial fisheries now developed to such a point that there was urgent demand for the abatement of the destruction to young fish by Chinese shrimp fishermen on which agitation had begun as early as 1885. This came as a result of investigations made by an expert which consumed several months' time. Statistics showing the amounts of the different varieties of fish sold in the San Francisco markets were prepared in order to show the need for protective legislation. The sturgeon, once of no market value, was found to be the highest priced fish on the market and with the supply insufficient to meet the demands, in spite of protective laws.

"As the hunting license law produced ample funds, and believing that the establishment of a State Game Farm where game birds could

be raised in captivity and operated along the same lines as fish hatcheries, would be in entire accord with the spirit of the law, which authorizes expenditures for the propagation and restoration of game, and being encouraged by the example of other states, it was decided to undertake the establishment of one in California. Negotiations for services were entered into with several men who had had experience on game farms in eastern states, also with Mr. J. R. Argabrite, a resident of California, who was a successful raiser of pheasants in Ventura County. This resulted in engaging the services of Mr. Argabrite in September, 1908. He was immediately detailed to examine and report on a number of different locations that had been offered for the estab-

FIG. 32. Pheasant chicks at the State Game Farm. Many pheasants and quail were reared on the farm between 1908 and 1918. Photograph by H. C. Bryant.

lishment of such an institution." (Bienn. Rpt. 1910.) A location was finally selected one mile south of Hayward, Alameda County, and a lease executed in November, 1908. A stock of pheasants was immediately secured together with four dozen Hungarian partridges. During the ten years of its existence the game farm reared and distributed several thousand pheasants, many quail and some wild turkeys. The expense of the farm seemed to be so out of proportion to the results obtained and the location so unfavorable for game propagation that the farm was finally abandoned in the fall of 1918. In the last years of its existence it was used more largely as an experiment station to determine the possibility of breeding different species of game birds and mammals.

When the game farm was first established there were a number of experiments made in the transplanting of native species. In 1908 and 1909, about three thousand quail were trapped and distributed in various sections of the state. About one thousand five hundred of this number were quail trapped in Lower California and liberated near Los Angeles. The incentive for these plants had its source in the mistaken idea that quail were decreasing because of inbreeding.

During the period 1910–1912, due to the concerted effort of Commissioner Newbert, public interest in fish and game conservation was aroused by directing and otherwise aiding in the formation of a representative protective organization, with a membership of over 16,000 sportsmen scattered through every county in the state. Each county sent representatives to Sacramento in order to aid in the formulation of the game laws so that the laws would be as fair to the people of the state as it was possible to make them. The organization, however, was short lived.

In 1912, Charles L. Gilmore was appointed by the Commission to make a stream survey, all of the available data to be recorded on maps together with fish distribution in proper position with reference to the locality of the actual plant. The best available sources of information and of statistical data were consulted and an intensive study made.

Beginning in 1913, the Fish and Game Commission started emphasizing scientific investigation of the many problems relating to fish and game. For these investigations experts from the State University and from Stanford University were secured. Professor Charles H. Gilbert undertook an inquiry into the life history of salmon and trout. Study of the life, abundance and conditions most favorable to the maintenance of our edible crabs was undertaken by Professor Frank W. Weymouth. A study of the clams of California was made by Harold Heath and one on abalones by Chas. L. Edwards. Complaint of the devastation caused by meadowlarks and other nongame birds led to the study of the relation of birds to agriculture by H. C. Bryant. At this time also, Miss Gretchen Libby was secured to conduct an educational campaign regarding wild life and wild life conservation in the schools of the state. Frank C. Clarke undertook an investigation of the deer problem and published a report.

On August 10, 1913, the employees of the Commission were included in the classified list of state employees under civil service. In this year also administrative divisions were established under the charge of branch offices at Sacramento, Los Angeles and Fresno.

Beginning in 1914, emphasis was placed on education and publicity, a separate department being inaugurated. Conservation work in the schools and in the summer resorts was undertaken, as well as the publication of a quarterly, CALIFORNIA FISH AND GAME, with the motto, "Conservation Through Education."

In 1917, in anticipation of an income from a newly established fisheries tax, scientific investigation of problems connected with the rapidly growing fisheries of the state were begun with the ultimate establishment of a State Fisheries Laboratory at San Pedro under the direction of Mr. W. F. Thompson. A patrol boat suitable for use in scientific work was built in 1918. A system of recording the catch of fish in order to furnish statistics of fluctuation and overfishing was also begun.

The game refuge as a means of game conservation came to the fore about 1909 but it was 1915 before extensive areas were set aside. In 1917, sixteen large areas were added making a total when the national parks and monuments are added of about 3,000,000 acres.

FIG. 33. The old Tahoe Hatchery as it appeared in 1906.

FIG. 34. The new Tahoe Hatchery completed August, 1920. **Photograph by M. E. Spaulding.**

In 1920, the Commission was operating sixteen fish hatcheries and six egg-collecting stations. The output in trout for the two-year period ending June 30, 1920, amounted to 34,000,000. In addition 29,000,000 Chinook salmon were hatched and distributed. Thus we find at the end of the fifty-year period that continued emphasis is being placed on fish propagation with attendant spectacular results.

PERSONNEL.

A succession of interested and discerning commissioners backed by a long list of faithful employees have combined to make a splendid working organization. The policy pursued by each newly appointed Commission of retaining employees instead of using political power to oust them has allowed certain policies to be continued through a term of years, without change and with correspondingly favorable results. The present head of the Fishculture Department, W. H. Shebley, and his assistant, E. W. Hunt, have served the Commisison continuously for thirty-five and thirty-two years respectively. The list of chief deputies and executive officers is very short considering the political changes during fifty years. The list on page 84 will furnish some idea of the men appointed by various Governors, as Fish and Game Commissioners.

Chief Deputies and Executive Officers.

John P. Babcock	December, 1892 October 15, 1901
Chas. A. Vogelsang	October 15, 1901 August 15, 1910
John P. Babcock	August 15, 1910 November 29, 1911
Ernest Schaeffle	November 29, 1911 September, 1916
Carl Westerfeld	December 8, 1916 April 28, 1920
Chas. A. Vogelsang	April 28, 1920—

CONSTRUCTIVE LEGISLATION AND COURT DECISIONS.

A number of court decisions have formed the ground work for the successful administration of fish and game laws, not only in California but in other states. The more outstanding cases have had to do with pollution, transportation and sale of fish and game. Brief statements regarding the more important ones follow:

It was in 1893 that the Supreme Court handed down a very important decision relative to the sale of venison. In the case of Simon Maier, the law making the possession of venison illegal during the closed season was upheld even though the deer might have been killed without the state.

Hide hunters were most active about 1880 when thousands of deer hides were shipped annually from Sacramento Valley towns, but a final cleanup of offenders did not come until 1893, when arrests were made in San Francisco and an important case won. Thereafter, violations of the deer law were less flagrant.

Several important game cases helped put a stop to illegal sale of game in the markets. A test case of the law fixing a limit on the number of quail, ducks, doves and other game birds that one person may possess during one calendar day was decided in favor of the people, and market men of San Francisco were forced to limit their supply to a single bag limit. Similar cases carried to the Supreme Court were decided favorably. Also the law prohibiting the sale of quail was upheld in the Supreme Court. Inspection of express shipments was begun in an effort to stop illicit shipping of game.

LIST OF FISH AND GAME COMMISSIONERS, 1870–1920.

Commissioner	Term of office	Home	Occupation	Recreation	Attainments in office
Hon. B. B. Redding	1870–1885	San Francisco	Lawyer	Angler	Introduction of fishes; striped bass.
Hon. S. R. Throckmorton	1870–1885	Sausalito	Capitalist	Naturalist	Introduction of fishes.
Hon. J. D. Farwell	1870–1885	San Francisco	Capitalist	Angler and sportsman	Introduction of fishes.
Hon. R. H. Buckingham	1885–1886	Broderick	Market fisherman; hotel man	Commercial fishing	Introduced carp.
Hon. A. B. Dibble	1885–1886	Grass Valley	Lawyer	All round sportsman	Restocking depleted streams.
Hon. T. J. Sherwood	1885–1886	Marysville	Newspaper man	Field sportsman	Developed interest in fish and game.
Hon. Joseph Routier	1886–1891	Routier	Fruit grower	Conservationist and field sportsman	Motto: "More fish"; conservation of game.
Hon. J. Downey Harvey	1886–1891	Los Angeles	Capitalist	All round sportsman	
Hon. Charles Josselyn	1886–1891	San Francisco	Ship chandler	Angler and sportsman	Propagation.
Hon. Joseph D. Redding	1891–Feb. 25, 1895	San Francisco	Lawyer	Angler and sportsman	Propagation.
Hon. Ramon E. Wilson	1891–Sept. 22, 1891	Napa	Lawyer	Angler and sportsman	Propagation.
Hon. Joseph Morizio	1891–Dec., 1892	Oakland	Commercial fisherman	All round sportsman	Commercial fisheries; propagation.
Hon. Hugh L. Macneil	Nov., 1892–Jan., 1895	Los Angeles	Capitalist; fruit grower		
Hon. William C. Murdock	Dec. 22, 1892–Sept., 1896	San Francisco	Capitalist	Sportsman and angler	Authority on fish and game.
Hon. H. F. Emeric	Feb.8, 1895–Sept., 1897	San Francisco	Rancher	Angler	Originated the "Emeric spinner."
Hon. J. M. Morrison	Mar. 12, 1895–Jun, 1899	Sacramento	Restaurant man	Trap shooter	County game warden law; law enforcement; introduction of game.
Hon. Alex. T. Vogelsang	Nov., 1896–April, 1901	San Francisco	Lawyer	Angler	Propagation of salmon and trout.
Hon. C. B. Gould	Sept., 1897–April, 1901	Oakland	Business man	Angler and sportsman	Fish propagation.
Hon. Henry W. Keller	June 20, 1899–April 24, 1903	Santa Monica	Capitalist	Sportsman	Conservation; urged bag limits and non-sale of game.
Hon. W. W. Van Arsdale	April 5, 1901–May, 1907	Ridgewood	Rancher; lumberman	Sportsman	Conservation.
Hon. W. E. Gerber	April 5, 1901–May, 1907	Sacramento	Rancher; banker	Trap shooter; sportsman	Introduction of game.
Hon. John Bermingham, Jr.	Mar. 23, 1905–July, 1908	Pinole	Superintendent powder works	Bass angler	Fish propagation and fish patrol.
Hon. George Stone	May 14, 1907–May, 1910	San Francisco	Capitalist		
Hon. F. W. Van Sicklen	June 25, 1907–Nov. 3, 1910	Alameda	Business man	Angler and sportsman	Game propagation and game farm.
Hon. M. J. Connell	July 15, 1908	Los Angeles	Capitalist	Angler and sportsman	Golden trout propagation and distribution.
Hon. Lendal N. Gray	Nov. 3,1910–Dec., 1910. Deceased	San Mateo	Shipping man	Angler and sportsman	
Hon. David Starr Jordan	Nov. 4, 1910–Aug. 4, 1911	Stanford University	College president	Ichthyologist	Conservation.
Hon. F. G. Sanborn	Jan. 21, 1911–Jan. 2, 1912	San Francisco	Business man	Angler	Fish and game propagation.
Hon. F. M. Newbert	Aug. 4, 1911	Sacramento	Merchant	Trap shooter; sportsman	Fish propagation; game protective association; untrammeled fishing rights.
Hon. Carl Westerfeld	Jan. 2, 1912–Dec. 8, 1916	San Francisco	Lawyer	Sportsman	Law enforcement; educational work.
Hon. E. L. Bosqui	Dec. 8, 1916	San Francisco	Printer	Angler	Commercial fisheries.

For several years the desire to curb the use of explosives in the capture of fish led to the offer of a reward of $25 for the arrest of any person killing fish by the use of powder or dynamite. For the two years ending September 1, 1898, nineteen cases where explosives had been used were prosecuted.

Owing to the efforts of the Commission a hunting license law was enacted in 1907, but the angler's license law was not enacted until 1913. The hunting license law met the approval of all those interested in the preservation of game and provided funds for a $20 bounty on mountain lions, after November, 1907.

In 1897, a case of importance which was brought before the courts was that against the Truckee Lumber Company for dumping sawdust in the Truckee River. The company maintained that the state had a right to protect fish only in navigable waters and that in all other waters the right is exclusively in the riparian proprietor. The Supreme Court ruled that the right to take fish extends to all waters and that therefore the title remains in the government. Also that the waters of the state furnish passageway for the fish and that they can not be subjected to private ownership. Further that the owner does not control all of the fish in the stream except as he reduces them to actual possession and that he can not kill or obstruct the free passage of those not taken.

Proper control of the transportation of game was attained by winning two important cases, one of which put the game transfer companies out of business and the other sustained the law prohibiting the use of parcel post in the shipment of game.

"For a number of years prior to 1913, there was an organized effort on the part of certain commission merchants in San Francisco to evade the limit law on ducks and to that end transfer companies were formed, which, while endeavoring to act as such, were, in fact, subterfuges of the several commission houses; for the reason that a transfer company is allowed to have in its possession more than the limit of ducks in one day, for the purpose of transportation only. When the Commission discovered this fact, all the ducks in the possession of the so-called transfer companies were seized. Thereafter, an action was brought in the Superior Court to restrain the Commission from seizing the ducks, so shipped, and for $5,000 damages. Judgment was rendered in favor of the Commission and against the plaintiff, for costs. Since the rendering of this decree, these so-called transfer companies have entirely gone out of business and it has reduced the unlawful distribution of ducks to less than one-half." (Bienn. Rept. 1914.)

The first legislation regarding the nonsale of game was brought before the people of California in 1893, when the market sale of deer was prohibited. In 1901, quail were taken from the market. But a crisis was reached when, in 1913, along with many other bills relating to fish and game, there was introduced into the legislature what has since been known as the "Flint-Cary bill," prohibiting the sale of wild ducks and wild pigeons, in addition to the wild game the sale of which had been previously forbidden.

This bill was passed by both houses and signed by the Governor, but those who had failed to prevent its passage, namely, the Northern California Hotel Men's Association and others, got up a referendum petition, which led to the setting aside of the bill until the general election, November 3, 1914. The law failed of passage in the November election, but a few years afterwards the federal law was passed which prohibits the market sale of any migratory game which accomplished the desired result.

In July 1914, on account of the decision that the Districting Act of 1913 was faulty, it became necessary to revise the act and to change many of the laws on the statutes. This was done at the 1915 session of the legislature.

On September 11, 1917, Frank Phoedovius was arrested in San Mateo County for shipping deer meat by parcel post. He was tried and convicted and sentenced to pay a fine of $25 or be imprisoned in the county jail until said sentence was satisfied, in proportion to one day's imprisonment for every dollar of said fine. The fact that the postal laws prevented inspection of any packages shipped by parcel post had been taken advantage of by the market hunters and fishermen. The decision in this case took from them the last avenue through which the game and fish of the state could be unlawfully exploited.

CONCLUSION.

These features of the work of the Commission have been selected more or less at random and doubtless there are many other accomplishments which deserve recognition. Such have been left out for the sake of brevity.

The above achievements have of course been accompanied with many discouragements and some failures, but the latter are overshadowed by these notable successes.

With such achievements as a background the future should yield a rich harvest of new attainments.

PUBLICATIONS OF THE CALIFORNIA FISH AND GAME COMMISSION, 1870-1920.

Compiled by HAROLD C. BRYANT.

INTRODUCTION.

A test of the efficiency of any organization whose function it is to administer natural resources is to be found in the actual published results of scientific research. Certainly, a Fish and Game Commission is not functioning correctly if legislation and current activities are not based on the carefully ascertained facts secured as a result of scientific inquiry. That the California Fish and Game Commission has not been remiss in this regard is evidenced by the following list of publications. Although compiled largely as an aid to those making use of published articles on the fish and game of this state, the list should bring forcefully to the minds of all readers the outstanding features in the work and accomplishments of the Commission during the fifty years of its existence.

The list is as near complete as it was possible to make it. As the files of the Commission were destroyed in the San Francisco fire of 1906, reference has been made to the files of the State Library and the University of California Library, as well as to files of the Fishcultural Department.

All of the publications listed with but one or two exceptions have been published by the State Department of Printing at Sacramento.

In some instances new series of bulletins have been started under different administrations without due regard to previous series. These have accordingly been designated as new series, to avoid duplication of bulletin numbers, although this designation does not appear on the bulletins themselves.

The serial publications of the Commission have been: (1) biennial reports (a report to the Governor required by law); (2) California fish and game laws (a compilation of the laws relating to fish and game for the use of deputies); (3) abstracts of California fish and game laws (cards giving a summary of the open seasons, bag limits and other regulations); (4) fish bulletins (publications giving the results of scientific investigations); (5) game bulletins (publications giving the results of scientific investigations); (6) teachers' bulletins (a series designed for the use of teachers in the public schools); (7) miscellaneous bulletins (miscellaneous reports on the work and accomplishments of the Commission and publications appearing irregularly); (8) CALIFORNIA FISH AND GAME (a quarterly magazine with the motto "Conservation Through Education"); (9) reprints and separates.

BIENNIAL REPORTS.

Report of the Commissioners of Fisheries of the State of California for the years 1870 and 1871. 1872; 24 pp.

Report of the Commissioners of Fisheries of the State of California for the years 1872 and 1873. 1874; 28 pp.

Report of the Commissioners of Fisheries of the State of California for the years 1874 and 1875. 1875; 36 pp.

Report of the Commissioners of Fisheries of the State of California for the years 1876 and 1877. 1877; 30 pp.

Report of the Commissioners of Fisheries of the State of California for the years 1878 and 1879. 1879; 63 pp.

a. Report upon the food fishes of San Francisco. By W. N. Lockington, pp. 17–58.

Report of the Commissioners of Fisheries of the State of California for the year 1880. 1880; 70 pp.

a. Report on the edible fishes of the Pacific Coast, U. S. A. By W. N. Lockington, pp. 16–66.

Biennial Report of the Commissioners of Fisheries of the State of California for 1881–1882. 1882; 23 pp.

Biennial Report of the Commissioners of Fisheries of the State of California for the years 1883–1884. 1884; 33 pp.

Biennial Report of the Commissioners of Fisheries of the State of California for the years 1885–1886. 1886; 31 pp.

Biennial Report of the State Board of Fish Commissioners of the State of California for the years 1886–1888. 1888; 15 pp.

Biennial Report of the State Board of Fish Commissioners of the State of California for the years 1888–1890. 1890; 67 pp. 4 pls.

a. Food fishes of the California fresh waters. By Carl H. Eigenmann, pp. 53–65.

b. Why salmon are scarce. By H. W. Harkness, pp. 66–67.

Biennial Report of the State Board of Fish Commissioners of the State of California, 1891–1892. 1892; 65 pp., 3 pl.

a. Salmon and trout of the Pacific Coast. By David Starr Jordan, pp. 44–58.

b. Description of a new species of trout (Salmo kamloops). By David Starr Jordan, pp. 60–61, 1 pl.

c. Description of the Golden trout of Kern River. By David Starr Jordan, pp. 62–65, 1 pl.

Thirteenth Biennial Report of the State Board of Fish Commissioners of the State of California, 1893–1894. 1894; 143 pp., 18 pl.

a. Report of observations respecting the oyster resources and oyster fishery of the Pacific Coast of the United States. By Charles H. Townsend, pp. 92–108.

b. Salmon and trout of the Pacific Coast. By David Starr Jordan, pp. 125–141, 7 pls.

c. Descriptions of new varieties of trout. By David Starr Jordan, pp. 142–143, 3 pls.

Fourteenth Biennial Report of the State Board of Fish Commissioners of the State of California, for the years 1895–1896. 1896; 108 pp., 28 pl.

Fifteenth Biennial Report of the State Board of Fish Commissioners of the State of California, for the years 1897–1898. 1900; 75 pp., 3 pls., 3 figs.

a. Report on the planting of quinnat salmon fry in the short coast streams of Marin County, California. By N. B. Scofield, pp.49–62, 3 pls.

b. Notes on the movements of the young of the steelhead trout in Marin County streams. By N. B. Scofield, pp. 63–65.

c. Notes on an investigation of the movement and rate of growth of the quinnat salmon fry in the Sacramento River. By N. B. Scofield, pp. 66–71.

Sixteenth Biennial Report of the State Board of Fish Commissioners of the State of California, for the years 1899–1900. 1900; 45 pp.

Seventeenth Biennial Report of the State Board of Fish Commissioners of the State of California, for the years 1901–1902. 1902; 76 pp., 3 pls., 7 figs.

a. The equity of the game laws. By a "convert," pp. 58–63.

b. Studies in the natural history of the Sacramento salmon. By Cloudsley Rutter, pp. 64–76, 1 pl.

Eighteenth Biennial Report of the State Board of Fish Commissioners of the State of California, for the years 1903–1904. 1904; 112 pp., 16 figs.

a. Pacific species of salmon and trout. By David Starr Jordan, pp. 75–97.

b. The parent-stream theory of the return of salmon. By David Starr Jordan, pp. 98–102.

c. Artificial propagation of salmon in the Sacramento River. By Cloudsley Rutter, with addenda by Commissioners, pp. 103–107, 1 fig.

Nineteenth Biennial Report of the State Board of Fish Commissioners of the State of California for the years 1904–1906. 1907; 112 pp., 3 colored pls., 29 figs.

a. The trout and salmon of the Pacific Coast. By David Starr Jordan, pp. 77–92, 11 figs.

b. Do quinnat salmon return to the native streams? By Cloudsley Rutter, pp. 93–97.

c. The golden trout of the southern High Sierras. By Barton Warren Evermann, pp. 98–112, 1 pl.

Twentieth Biennial Report and Financial Statement of the State Board of Fish Commissioners for the years 1907–1908. (Not printed for distribution but appearing in the Appendix of the Twenty-first Biennial Report, pp. 75–79.)

*Twenty-first Biennial Report of the Board of Fish Commissioners of the State of California, for the years 1909–1910. 1910; 127 pp., 8 colored pls., 16 figs.

a. Notes on the striped bass in California. By N. B. Scofield, pp. 104–109, 1 pl.

b. Notes on spawning and hatching of striped bass eggs at Bouldin Island Hatchery. By N. B. Scofield and G. A. Coleman, pp. 109–117, 3 figs.

c. Pheasant raising. By Chas. A. Vogelsang, pp. 118–124, 1 pl., 1 fig.

d. Diseases of pheasants. By George B. Morse, M.D., V.S., pp. 124–127.

*Twenty-second Biennial Report of the Fish and Game Commission of the State of California, for the years 1910–1912. 1913; 80 pp., 5 figs.

*Twenty-third Biennial Report of the Fish and Game Commission of the State of California, for the years 1912–1914. 1914; 166 pp., 34 figs.

a. Arid California and its animal life. By Frank Stevens, pp. 127–135, 2 figs.

b. The California fish industry from a commercial point of view. By F. E. Booth, pp. 136–140, 1 fig.

c. The National Forests in California. By W. C. Hodge, pp. 141–150, 3 figs.

d. The American army of hunters. By Ernest Schaeffle, pp. 151–152.

NOTE.—Beginning with the Twenty-fourth, the Biennial Report consists of the report only, such papers as had been included heretofore being henceforth published as bulletins or in the quarterly CALIFORNIA FISH AND GAME.

*Twenty-fourth Biennial Report of the Fish and Game Commission of the State of California, for the years 1914–1916; 248 pp., 88 figs., 1 colored pl.

*Twenty-fifth Biennial Report of the Fish and Game Commission of the State of California, for the years 1916–1918; 98 pp., 11 figs.

*Twenty-sixth Biennial Report of the Fish and Game Commission of the State of California, for the years 1918–1920. 1921; 149 pp., 28 figs.

CALIFORNIA FISH AND GAME LAWS.

1885 The Fish and Game laws of the State of California; published by authority of the State Board of Fish Commissioners; 1st ed., 77 pp.

1886 (No record available of 2d edition.)

1887 The Fish and Game laws of the State of California; published by authority of the State Board of Fish Commissioners; 3d ed., 80 pp.

1889 The Fish and Game laws of the State of California; published by authority of the State Board of Fish Commissioners; 4th ed., 86 pp.

*Publications still available for distribution are marked with an asterisk.

1891 The Fish and Game laws of the State of California; published by auth of the State Board of Fish Commissioners; 5th ed., 84 pp.
1893 The Fish and Game laws of the State of California; published by auth of the State Board of Fish Commissioners, compiled by F. P. Dec attorney for the Board; 6th ed., 142 pp.
1895 The Fish and Game laws of the State of California; published by auth of the State Board of Fish Commissioners, compiled by Arthu Fletcher, clerk of the Board; 7th ed., 55 pp.
1897 The Fish and Game laws of the State of California; published by auth of the State Board of Fish Commissioners, compiled by Arthu Fletcher, clerk of the Board; 8th ed., 55 pp.
1899 The Fish and Game laws of the State of California; published by of the State Board of Fish Commissioners; 9th ed., 32 pp.
1901 The Fish and Game laws of the State of California; published by of the State Board of Fish Commissioners; 10th ed., 48 pp.
1903 The Fish and Game laws of the State of California; published by of the State Board of Fish Commissioners, compiled by Chas. sang; 11th ed., 48 pp.
1905 The Fish and Game laws of the State of California; published by of the State Board of Fish Commissioners, compiled by Chas. sang; 12th ed., 52 pp.
1907 The Fish and Game laws of the State of California; published by of the State Board of Fish Commissioners, compiled by Chas. sang; 13th ed., 64 pp.
1909 The Fish and Game laws of the State of California; published by of the State Board of Fish and Game Commissioners, com Chas. A. Vogelsang; 14th ed., 80 pp.
1911–12 State of California Fish and Game Laws; compiled and published of the State Board of Fish and Game Commissioners; 15th ed.
1913–14 State of California Fish and Game Laws; compiled and published of the State Board of Fish and Game Commissioners, arra Ernest Schaeffle, Assistant Commissioner; 16th ed., 123 pp.
1914–15 State of California Fish and Game Laws; published by the Board and Game Commissioners, arranged by Ernest Schaeffle, Assista missioner; 17th ed., 130 pp.
1915–17 State of California Fish and Game Laws; published by the Board and Game Commissioners, arranged by John P. Fisher, game 18th ed., 144 pp.
1915–17 State of California Fish and Game Laws; published by the Board and Game Commissioners, arranged by John P. Fisher, in charg department; 19th ed., 144 pp.
1917–19 State of California Laws relating to Fish and Game; published Board of Fish and Game Commissioners, arranged by J. S. assistant executive officer; 20th ed., 180 pp.
1919–21 *State of California Laws relating to Fish and Game; published Board of Fish and Game Commissioners, arranged by J. S. assistant executive officer; 21st ed., 201 pp.

ABSTRACT OF FISH AND GAME LAWS.

Abstract of California Fish and Game Laws; first published in 1903 (?); bie to 1920. (Two sizes, one for mailing, the other as a poster.)
Abstract of Laws pertaining to Commercial Fisheries.
1915–1917.
1917–1919.
1919-1921.

FISH BULLETINS.

1. Report on fish conditions; 1913; 48 pp., 3 figs. Contains:
   a. The abalone industry in California. By Charles Lincoln Edwards.
   b. The towing of salmon and steelhead fry from Sacramento to the s "live car." By N. B. Scofield.
   c. The problem of the spiny lobster. By Bennet M. Allen.
   d. Investigation of the clams of California. By Harold Heath.

*Publications still available for distribution are marked with an asterisk.

e. Investigation of the life history of the edible crab (*Cancer magister*). By F. W. Weymouth.
f. A general report on a quinnat salmon investigation carried on during the spring and summer of 1911. By N. B. Scofield.
g. Trout and black bass planting and transplanting in the San Joaquin and Southern Sierra districts. By. A. D. Ferguson.

*The scientific investigation of marine fisheries as related to the work of the Fish and Game Commission in Southern California. By Will F. Thompson. 1919;

By Will F. Thompson,
pp., 9 figs.
By Frank W. Weymouth.
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ast. By Edwin C. Starks.

STATE OF CALIFORNIA

ARTMENT OF NATURAL RESOURCES

IVISION OF FISH AND GAME

t No. 2 San Francisco September, 1929

CALIFORNIA'S PROTECTION AND RESTORATION PROGRAM

Division of Fish and Game has stewardship hunting and fishing attractions of California. making a serious effort to conserve and restore life resources. It is confronted with difficult ems. Among the most perplexing is the enance of fish and game in the face of a ng civilization, which is rapidly changing and ying the natural environment and at the same taking a large toll.

ring the past ten years the number of license s has doubled. Nor does the mounting num- of those who consider fishing and hunting favorite sport hold any promise of waning. dy over half a million citizens find abundant tion and exhilarating pleasure in pursuits rod and gun. Contacts with the out-of-doors them to live more wholesome lives; to find from what Herbert Hoover calls "the drab- f civilization."

insure for the future an adequate supply of nd game and to offset the manifold possibili- f depletion through unwise use, the Division

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irds. By H. C. Bryant.

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The Fish and Game laws of the State of California; published by authority of the State Board of Fish Commissioners; 5th ed., 84 pp.
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is employing methods which past experience and scientific knowledge prove fundamental.

In order to afford natural food, shelter and safety to game species hunting has been prohibited in over 3,000,000 acres of existing remnants of primitive area. Game refuges number nearly forty. Reclamation, drainage and evaporation are responsible for the reduction of at least 80 per cent of water areas formerly eminently suited as loafing and feeding grounds for myriads of waterfowl. A survey now being conducted will result in the purchase and establishment from allotted funds of additional refuges and public shooting grounds and the great improvement of these conditions.

The Division keeps an actual record of the number of deer legally killed. It knows that 21,515 deer were killed in the season of 1928 and that this was 2,008 more deer than were killed in 1927. It also knows the number of fur bearers taken by trappers. Data as to the catch of food fish is required by law. Such statistics are of great value. If records show that a species suffers progressive diminution from year to year, depletion has set in and proper steps can be taken to avert further impairment. Ability to detect when the breeding stock of a particular species is being depleted is fundamental in the control and regulation of hunting and fishing.

To enforce effectively the fish and game laws, the Division must maintain a policy of constant watchfulness. Exactly 120 regular deputies and over 850 volunteer wardens patrol some 150,000

ABSTRA

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lished one of the largest single under-wire enclosures of its kind. At this game farm pheasants, quail, partridges and other game birds are artificially produced. In 1926, plants were made of 3,420 Chinese ring-necked pheasants, in 1927, of 7,706 pheasants and in 1928, of 6,106 pheasants. A second game farm constructed in the summer of 1929 in southern California will soon produce many more thousands of pheasants.

All the work of the Division in conserving and restoring fish and game resources is not supported by taxation, but solely by hunting and angling licenses, fines imposed by the courts for violations of the fish and game laws, and the licenses paid by trappers, deer hunters, game and fish breeders, commercial hunting club operators and commercial fishermen and privileged taxes paid by fish canners.

It is evident by the foregoing that the Division is making earnest effort to fulfill the duties wisely imposed by law. By placing emphasis on protection, law enforcement, artificial reproduction, education and scientific research, it is making sure a future for fish and game resources.

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CALIFORNIA STATE PRINTING OFFICE
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g. Trout and black bass planting and transplanting in the San Joaquin and Southern Sierra districts. By. A. D. Ferguson.

2. *The scientific investigation of marine fisheries as related to the work of the Fish and Game Commission in Southern California. By Will F. Thompson. 1919; 27 pp., 4 figs.
3. *The spawning of the grunion (*Leuresthes tenuis*). By Will F. Thompson, assisted by Julia Bell Thompson. July 15, 1919; 29 pp., 9 figs.
4. *The edible clams, mussels and scallops of California. By Frank W. Weymouth. January 10, 1921; 74 pp., 19 pls., 26 figs. (In press.)
5. *A key to the families of marine fishes of the west coast. By Edwin C. Starks. March 3, 1921; 16 pp., 4 figs. (In press.)

GAME BULLETINS.

1. *Report on game conditions; 1913; 67 pp., 8 figs. Contains:
   a. Investigation of the large game situation in California with special reference to deer. By Frank C. Clarke.
   b. Present and future status of the California valley quail. By Harold C. Bryant.
   c. Introduction of foreign game birds into the southern San Joaquin and tributary sections. By A. D. Ferguson.
   d. Educating the young people as to the need and value of wild life conservation. By Gretchen L. Libby.
   e. Investigation of the economic status of nongame birds. By H. C. Bryant.

TEACHERS' BULLETINS.

1. *A few reasons for teaching bird study in the schools. [By Gretchen L. Libby.] 1912; 4 pp.
2. *Birds as rodent destroyers. [By Gretchen L. Libby.] 1912; 4 pp.
3. *Owls. [By Gretchen L. Libby.] 1912; 4 pp.
4. Game conservation and its importance. [By Gretchen L. Libby.] 1913; 4 pp.
5. *Game conservation and its importance. [By Gretchen L. Libby] (continued from No. 4). 1913; 4 pp.
6. *Bats as desirable citizens. By Joseph Grinnell. 1916; 4 pp.
7. *The European house sparrow and its control in California. By Harold C. Bryant. 1916; 8 pp., 6 figs.

GENERAL.

MISCELLANEOUS BULLETINS.

SERIES A.

No. 1. Short report on classification of certain fish found in the Eel River, as steelhead trout, in salt water during month of September. By David Starr Jordan. October 12, 1891.
No. 2. Short report on classification of certain fish found in Webber Lake as *Salmo mykiss henshawi* (cut-throat). By David Starr Jordan. October 12, 1891.
No. 3. Short report on classification of certain fish found in Klamath River as steelhead trout, *Salmo gairdneri*. By David Starr Jordan. October 24, 1891.
No. 4. Salmon and trout of the Pacific Coast. By David Starr Jordan. February 15, 1892; 19 pp.
No. 5. Enforcement of game ordinance of city and county of San Francisco. March 15, 1892.
No. 6. Classification of the trout caught in Mount Whitney Creek. July 12, 1892.

SERIES B.

No. 1. Pheasant raising. By Chas. A. Vogelsang. 1910; 12 pp., 1 fig. Contains also: Diseases of pheasants. By Geo. B. Morse; pp. 9-12.

*Publications still available for distribution are marked with an asterisk.

SERIES C.

No. 1. Statement by Commissioners. 1911; 23 pp. (Relative to activities of the Commission.)
a. Excerpt from report on crab investigation. By F. W. Weymouth.
b. Bird investigation. Letter written by H. C. Bryant to the editor of the San Bernardino "Sun."
No. 2. Bird study in the schools. By Gretchen L. Libby. 1912; 49 pp., 1 fig.

SERIES D.

No. 100. *Deer in relation to young orchards. By A. D. Ferguson: Farmers' Bulletin. January, 1914; 4 pp.

EXTRA SERIES (not numbered).

How to liberate game birds; date (?); 1 p.
Receipts, disbursements and transactions for period from July 1, 1910 to June 30, 1912. December 23, 1912; 4 pp. (printed on one side only).
Statement from the Fish and Game Commission. 1912; 1 p.
*Your Fish and Game—Swat the market hunter and give the boy a chance. 1913 (?); 14 pp. illus.
Statement from the Fish and Game Commission. 1913 (?); 4 pp., 1 map inclosed. (In reference to nonsale of game.)
*Conservation through education. 1915 (?); 14 pp., illustrations in color.

CALIFORNIA FISH AND GAME.

A publication devoted to the conservation of wild life and published quarterly by the California Fish and Game Commission.

VOL. I. 1914–1915.
No. 1. October,.
No. 2. January 30.
No. 3. April 10.
No. 4. July 15.
No. 5. October 15.

VOL. II. 1916.
No. 1. January 15.
No. 2. April 15. (Shad number.)
No. 3. July 24. (Deer number.)
No. 4. October 18.

VOL. III. 1917.
No. 1. January 20.
No. 2. April 15.
No. 3. July 20.
No. 4. October 27.

VOL. IV. 1918.
No. 1. January 28. (Herring number.)
No. 2. April 15.
No. 3. July 15. (Kelp number.)
No. 4. October 25.

VOL. V. 1919.
No. 1. January. (Published February 3, 1919.)
No. 2. April 21.
No. 3. July 15. (Trout number.)
No. 4. October 21.

VOL. VI. 1920.
No. 1. January 15.
No. 2. April 19.
No. 3. July 26.
No. 4. October 28.

REPRINTS AND SEPARATES—CALIFORNIA FISH AND GAME.

VOL. I.

No. 1. *Bird life as a community asset. By Joseph Grinnell. October, 1914; 3 pp.
No. 2. *The wood duck in California. By Joseph Grinnell and H. C. Bryant. January 30, 1915; 4 pp.
No. 3. *The Tennessee possum has arrived in California. By Joseph Grinnell. April 10, 1915; 3 pp., 1 fig.
No. 3. *An attempt to save California elk. By B. W. Evermann. April 10, 1915; 11 pp., 8 figs.
No. 3. *California's fur-bearing mammals. By Harold C. Bryant. April 10, 1915; 12 pp., 2 figs.
No. 4. *Books and pamphlets relating to California birds. By H. C. Bryant. July 15, 1915; 3 pp.
No. 4. *Two kinds of conservationists. By W. P. Taylor. July 15, 1915; 3 pp.
No. 5. *Some hints on making photographs for illustrations. By Tracy I. Storer. October 15, 1915; 4 pp.

*Publications still available for distribution are marked with an asterisk.

VOL. II.

No. 1. *Science and progress in the protection of forest, fish and game animals. By Chas. C. Adams. January 15, 1916; 4 pp.
No. 2. *The California valley elk. By B. W. Evermann. April 15, 1916; 8 pp., 1 fig.
No. 2. *Does the grizzly bear still exist in California? By Joseph Dixon. April 15, 1916; 5 pp., 4 figs.
No. 3. *The timber wolf in California. By Joseph Dixon. July 24, 1916; 3 pp., 3 figs.
No. 4. *A possible enemy of the mosquito. By Clarence Hamilton Kennedy. October 18, 1916; 4 pp., 4 figs.

VOL. III.

No. 1. *Scientific nature study in the public schools. By Georgie V. Miller. January 20, 1917; 3 pp.
No. 1. *History of the introduction of food and game fishes into the waters of California. By W. H. Shebley. January 20, 1917; 10 pp., 2 figs.
No. 3. *Devilfish and squid. By Harold Heath. July 20, 1917; 6 pp., 4 figs.
No. 4. The sharks of California. By E. C. Starks. October 27, 1917; 8 pp., 13 figs.
No. 4. *Temperature and the albacore. By W. F. Thompson. October 27, 1917; 7 pp.

VOL. IV.

No. 1. *The skates and rays of California, with an account of the rat fish. By E. C. Starks. January 28, 1918; 15 pp., 18 figs.
No. 2. *The herrings and herring-like fishes of California. By Edwin C. Starks. April 15, 1918; 8 pp., 9 figs.
No. 3. *The mackerel and mackerel-like fishes of California. By E. C. Starks. July 15, 1918; 13 pp., 12 figs.
No. 3. *The mussels of the Pacific Coast. By Edward P. Rankin. July 15, 1918; 5 pp., 4 figs.
No. 3. *Discretionary powers and game conservation. By Harold C. Bryant. July 15, 1918; 5 pp.
No. 4. *The flat fishes of California. By Edwin C. Starks. October 25, 1918; 19 pp., 22 figs.

VOL. V.

No. 1. *Shrimp fisheries of California. By N. B. Scofield. February 3, 1919; 12 pp., 5 figs.
No. 1. *The fishes of the croaker family (*Scianenidæ*) of California. By E. C. Starks. February 3, 1919; 8 pp., 8 figs.
No. 2. *The basses and bass-like fishes of California (families *Serranidæ*, *Hæmulidæ* and *Kyphosidæ*). By E. C. Starks. April 21, 1919; 10 pp., 9 figs.
No. 2. *The conservation of our fisheries. By W. F. Thompson. April 21, 1919; 11 pp., 4 figs.
No. 3. *California trout. By Barton Warren Evermann and Harold C. Bryant. July 15, 1919; 30 pp., 12 figs.
No. 4. *Some notes on dry-fly fishing, No. 1. By R. L. M., California. October 21, 1919; 2 pp.

VOL. VI.

No. 1. *Notes on dry-fly fishing, No. 2. By R. L. M., California. January 15, 1920; 5 pp.
No. 1. *California's game sanctuaries. January 15, 1920; 1 p.
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No. 1. *The Pacific edible crab and its near relatives. By Frank Walter Weymouth. January 15, 1920; 3 pp., 4 figs.
No. 1. The proposed investigation of the sardine. By Will F. Thompson. January 15, 1920; 2 pp.
No. 2. *The abalones of northern California. By Will F. Thompson. April 19, 1920; 5 pp., 3 figs.
No. 2. *Some notes on dry-fly fishing, No. 3. By R. L. M. April 19, 1920; 10 pp., 4 figs.
No. 3. *Notes on dry-fly fishing, No. 3. By R. L. M. July 26, 1920; 10 pp., 4 figs.
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*Report of Superintendent of Game Farm. By W. N. Dirks; 12 pp., 2 figs. (From Biennial Report of 1914.)

Arid California and its animal life. By Frank Stephens; 9 pp., 2 figs. (From Biennial Report of 1914.)

The California fish industry from a commercial point of view. By F. E. Booth; 5 pp. (From Biennial Report of 1914.)

The national forests in California. By W. C. Hodge; 8 pp., 4 figs. (From Biennial Report of 1914.)

REPRINTS—GAME BULLETINS.

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SEPARATES—CALIFORNIA FISH AND GAME LAWS.

*Act authorizing and regulating rearing and selling of domesticated fish. (Enacted 1911.) (Separate California Game Laws 1911–13, pp. 75–80.)

*Bowman Law (game farming). (Enacted 1913.) (Separate from California game laws 1913–1915, pp. 67–73.)

FINDING LIST OF SUBJECTS.

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R B—Reprint, Biennial Report.
R G B—Reprint, Game Bulletin.
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MAPS.

Outline map of California. By Chas. L. Gilmore. 1914.

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THE CONTROL OF THE MOUNTAIN LION IN CALIFORNIA.

By J. S. Hunter.

The one predatory animal for which practically no good can be said is the mountain lion. This animal without doubt kills more deer in California than are killed by all of the hunters. They also destroy a great many domestic animals. The actual meat value of the game and domestic animals destroyed by lions is impossible to estimate but it is safe to say that it runs into thousands of dollars.

During the many years that the Fish and Game Commission has been paying a bounty for every lion killed, hundreds have been taken, and up to January 1, 1920, $65,550 had been paid out in bounties.

In August, 1917, the amount paid for the killing of a female lion was increased from $20 to $30. Between that date and January, 1920, females to the number of 218 were sent in. Many requests have been made to the Commission that the bounty be still further increased. It is doubtful whether there would be any increase in the number killed even though the bounty were doubled. Most lions are killed either for the sport or on account of their destroying stock. The bounty is not the chief factor, but only an incident. In general as soon as a lion is reported there is a small army of hunters scouring the country, all anxious to boast of having killed a lion.

Contrary to the general opinion lions are not abundant in any part of the state. From the accompanying table it will be noted that Humboldt County leads with a total of 564 killed during twelve years time. The animal has been so reduced in that county that the kill has dropped from 113 in 1908 to 8 in 1919. In Shasta County, the next on the list, the kill has been less than one-half, 261 killed during the same period. Here, however, the animals have apparently not been reduced to the same extent as the kill in 1919 was approximately the same as in 1908.

In Trinity County 260 have been killed; last year only 14 as against 18 in 1908. In Siskiyou County none were killed last year; but in 1908 the number totaled 31 and in the twelve-year period 241. From this it would seem that lions in Siskiyou County are greatly reduced if not practically exterminated. Only one other county, Mendocino, reports more than 200 the first twelve years. In that county 219 have been killed; the number (22) taken in 1919 is just one-half those killed in 1908. Tehama County killed three during 1919, as against 31 in 1908, making a total of 159 in twelve years.

It is evident from the above figures that California lions are being slowly reduced in number and that the animals killed approximately if not entirely exceed the natural increase. If this is true we can form a very good idea as to the number of lions in the state. Forty-two per cent of the lions sent in for bounty are females. The female lion does not bring forth a litter every year but only every other year. Sometimes three kittens are born but the usual number is two. This would make the kill of 243 in 1919 the offspring of 243 females or 42 per cent of the total number of lions in the state. This calculation would give a lion population in California of about 575, which we believe is somewhere near the actual number.

This number of lions can do an enormous amount of damage to the deer. The minimum estimate of the number of deer killed by a single lion each year has been placed at fifty-two. Five hundred seventy-five lions will kill at least 30,000 deer during the year if deer are available and deer are common in every part of the state where lions are found.

The California Fish and Game Commission has determined to make every effort to still further reduce the number of lions. Knowing the increase of hunters and the ease with which hunters can reach what were formerly the most inaccessible places it will be necessary to stop

FIG. 35. Jay Bruce, state lion hunter, and his dogs. The Fish and Game Commission hires Mr. Bruce to cut down the number of mountain lions in the state game refuges.

the heavy natural drain on the deer supply caused by this animal. On this account an expert lion hunter has been employed. This man, Jay C. Bruce, is one of the best lion hunters in the country. In fact, the attention of the Commission was called to Mr. Bruce because of the many lions which he sent in for bounty from Mariposa County.

Mr. Bruce was born in Mariposa County and spent a great deal of his time in the mountains becoming thoroughly familiar with the habits of the animals of the forest. On account of an injury to his left hand

while working in a lumber mill he was forced to secure other employment and turned to that line of work for which his life long training had fitted him. On account of the bounty paid for the killing of lions he devoted considerable time to trailing them with dogs and was very successful.

His success as a lion hunter is due to the fact that he has made a study of the habits of the California lion and knows their habits thoroughly; also to the fact that he is an expert dog trainer and has his dogs trained so that they will follow only the tracks of either a bobcat or a lion and of no other animal. On account of this he can work without difficulty where deer are abundant. These dogs will never take the trail of a deer.

Since Mr. Bruce has been employed by the Commission he has worked chiefly in the game refuges and has made an excellent record. His greatest kill during any one month has been eight lions. Because of the success of the attempt to control the mountain lion it is the intention of the Commission to keep Mr. Bruce employed and later, perhaps, to employ other lion hunters.

Mountain Lion Bounties, 1907 to 1919—By Counties.

County	1907 to 1917	1918	1919	County	1907 to 1917	1918	1919
Humboldt	564	22	8	Santa Clara	19	3	2
Shasta	261	26	30	Colusa	17	3	---
Trinity	260	12	14	Calaveras	13	---	2
Siskiyou	241	1	---	Amador	9	---	---
Mendocino	219	18	22	Orange	9	2	1
Tehama	159	6	3	Plumas	9	---	---
Kern	134	10	15	Stanislaus	9	1	1
Lake	106	11	9	Inyo	7	---	1
Monterey	105	12	19	Lassen	7	---	1
Santa Barbara	99	6	19	Mono	7	---	---
Del Norte	97	2	5	Nevada	7	2	---
Tulare	95	11	17	Sierra	6	---	---
Mariposa	77	12	5	Modoc	4	1	---
San Luis Obispo	76	3	6	Yuba	4	---	1
Tuolumne	75	9	12	Napa	3	---	---
Los Angeles	49	8	9	San Joaquin	2	---	---
El Dorado	48	1	8	Santa Cruz	2	---	1
Glenn	43	3	3	Sutter	2	---	1
San Diego	41	4	5	Alameda	1	---	---
Ventura	40	2	2	Alpine	1	---	---
Madera	39	5	1	Imperial	1	---	---
Placer	37	2	3	Merced	1	---	---
Butte	33	---	2	Sacramento	1	---	1
San Benito	33	2	1	San Mateo	1	---	---
Riverside	29	4	5	Kings	1	---	---
San Bernardino	23	5	3				
Fresno	22	3	4	Totals	3,170	241	214
Sonoma	22	2	1	Grand total			3,627

HUNTING THE WILD BOAR IN CENTRAL FRANCE.

By W. L. Scofield.

We were at the dinner table when a Frenchman rushed in waving his arms and talking at the top of his voice a stream like a high pressure fire hose. Lunch was finished in an uproar. Finally I found there had been no murder but that a wild boar had been seen at the edge of town. Flambo, the reliable old hunting hound, was out calling on his friends so the gray haired patrone of the hotel stepped to the door and wound several blasts on a cow-horn. Flambo arrived on the lope and I supposed we were ready to start, but not so. We talked about it for another hour and had other glasses of wine all round. By this time other cow-horns were tooting and other mighty hunters arrived at the hotel with shotguns and game bags large enough to carry the tail of a good sized boar.

Finally eight of us were ready to start with seven shotguns, four game bags, one hound and five cow-horns. So we had another glass of wine, talked some more and started for the communal forest about a mile from town. We followed a trail through thick growth along a stream where boars might besport themselves on sunny afternoons, the dog on a string that choked him till his tongue hung out, high tension jabber from all the men and every few minutes some imbecile would let out a blast on his horn for the purpose of adding to the general hilarity and scaring all the game for miles around. Wooden shoes clattered and animated conversation continued till the dog took the trail and then the racket increased instead of subsiding.

We trailed the boar to a thicket and separated to surround him. Guns were unlimbered, conversation increased if possible, the dog was loosed so he could breathe again and chase the boar out of the thicket but we found the boar was not in the thicket. Instead of sitting down and waiting to be surrounded when he heard the uproar the fool boar had wandered off somewhere else so after a half hour's conversation about it we trailed him to the next thicket and repeated the same performance.

This continued all afternoon and furnished ammunition for the most exciting conversation but no boar. I came to realize that conversation was the chief object of the occasion. If we quietly surrounded the boar someone might kill him and then there would be no boar to hunt and talk about another day. My trouble was that I had gone out on a talking expedition without sufficient knowledge of the language so I took a walk alone to look over the country. Toward evening I had no difficulty in finding the hunters for I could hear the din for a couple of miles. We returned to the hotel having been without wine for more than three hours. Half the village gathered in the hotel kitchen to talk about the hunt. At odd times we had some supper and I retired at eleven o'clock with the talk still running at fever heat.

THE ABUNDANCE OF YOUNG PISMO CLAMS.*

By FRANK W. WEYMOUTH, Stanford University.

While collecting data for the study of the life history of the Pismo clam some interesting facts regarding the abundance and fluctuations in number of the young have come to light.

During the spring and summer of 1919 the young of the preceding summer (1918) were difficult to obtain. In the fall of 1919 the young of that summer were first observed and have been noted in almost incredible numbers up to the present time. During the present fall (1920) a special search for the young of the current year has been made but only a few specimens have been obtained, indicating an even poorer spawning year than that of 1918.

Before comparing in more detail the relative success of the three spawning seasons it may be well to give some idea of the habits of the young and the methods used in estimating their numbers. The young of the Pismo clam is found for the first three years chiefly between tides where it is easly studied. At low tide on the long Pismo-Oceano beach the firm wet sand which proves so good a road for automobiles is the zone of their greatest abundance and many can be turned up by digging down an inch or so with the fingers. A more striking idea of their numbers may sometimes be gained after an unusually low tide when this area has been left dry for some time. A tiny hole then often appears above the siphon or "neck" of each clam and at times due, apparently, to their movements a little mound is raised above each animal. A view of the beach at such a time is shown in Figure 36 and gives a vivid idea of the abundance of the young clams.

An actual count of the numbers of young clams has been made at intervals in the following way: A shallow trench the width of a clam fork (9½ inches) was dug across the entire wet beach and into the water at low tide (see Fig 37). All the clams found were sorted into age groups, as is easily done by differences of size in the young, and the number of each age counted. They were found chiefly in a narrow zone some 20 to 30 yards wide corresponding to the roughened areas shown in the photograph; above and below this scattering clams were found, but more than nine-tenths of the young were concentrated here. The actual counts made over a period of about a year and a half range from 1294 to 774.

The young spawned in 1919 are, in all collections since their appearance, the most numerous, forming never less than 98 per cent of the total. Those of the previous year (1918) form from 0.88 per cent to 1.32 per cent, while in the two last counts in which the young of the current year (1920) are represented they form only one-fourth of one per cent. Other years, when the young were as abundant as in 1919, are reported by the diggers but seem to come several seasons apart.

The total numbers of young occurring in the entire beach as the result of a successful season such as 1919 is amazing. The productive area of the Pismo-Oceano beach is some eight miles in length; of this the northern third is by far the most thickly populated. The count was not made at the northern end, but near the middle of the beach

*California State Fisheries Laboratory, contribution No. 23.

where the conditions more nearly represent a fair average. A conservative estimate of the total number might be gained by considering six miles of beach with the numbers found in the region examined. Taking an average of the more recent counts when 800 young of 1919 were present in a cross section of the beach 9½ inches wide, a mile would contain 5,150,000 and six miles 30,900,000 clams. Other earlier counts would bring the total to 45,000,000. To this must be added the beach at Morro which, though not examined for this purpose, probably would double the present estimate.

FIG. 36. View taken on Pismo beach at low tide. Note pits and raised areas mentioned in the text; every pit or mound indicates a clam and there are other clams that show neither. Photograph by F. W. Weymouth.

Several important lessons should be drawn from this. When conditions are favorable the young of the Pismo clam are produced and given a foothold in such enormous numbers that the supply of adults should be secure if the young have a fair show. But the "if" should not be forgotten. Large numbers die from natural causes over which we have no control. But there are losses which could be prevented. In order to protect the Pismo clam, laws setting a size limit of 4¾ inches and a bag limit of 36 have been enacted. Many tourists and summer visitors, however, thoughtlessly dig these young that are so easily found

between tides and because they are so small take hundreds to furnish a single meal. The digging of an equal number of those of legal size would violate the bag limit but in realty would do less harm, as most of those which have reached a length of 4¾ inches have spawned, thus leaving behind them clams to fill their places. It is unfortunately true that other people including residents with undoubted knowledge of the law also take these young in large numbers. Unless these violations of a wise and necessary law are stopped by the cooperation of all interested people, their disastrous effects must soon be felt. All local residents that value the Pismo clam as a peculiar and distinctive local product should take every means possible to protect the young and to inform tourists and visitors of the need for its protection. With proper protection there is no reason why the Pismo clam should not remain a local

FIG. 37. Portion of trench made in counting young Pismo clams. All the clams shown came from a strip the width of the clam fork shown in the photograph (9½ inches). Photograph by F. W. Weymouth.

asset—with continued destruction of young before they have spawned as well as the taking of the adults of legal size, it will only be a question of time when this fine clam will be practically exterminated.

Another phase of the scientific work of the Fish and Game Commission is apparent here. The effect of an unusually good spawning year upon a fishery such as the sardine was discussed in the January issue.* Because of the ease with which the young of this clam may be studied we have here an even more striking example of such a successful spawning year in the season of 1919 which exceeds that of 1918 by seventy-five to one hundred times and that of 1920 by about four hundred times. According to reports the last season producing comparable numbers was four or five years ago. Evidently, for a number of years the clams

*See "The Future of the Sardine," by Will F. Thompson, CALIFORNIA FISH AND GAME, Vol. 7, pages 38-41.

spawned in 1919 will form the dominant class and when they reach legal size there will be an unusually good yield of clams. With a complete knowledge of the age reached and the rate of growth of the Pismo clam it would be possible to predict the future yield quite accurately from a yearly examination of the young such as here described.

Present indications are that the effect of this spawning year will be felt in 1925 and 1926, provided that proper protection is afforded the young in the meantime.

QUARTER-OILS OR HALF-POUND OVALS.*

By WILL F. THOMPSON.

(California State Fisheries Laboratory, contribution No. 24.)

One of the great problems which presents itself to the student of fisheries, that of the effect of occasional successful spawning years, was considered in relation to the sardine, in the last issue of CALIFORNIA FISH AND GAME. It was shown that the presence or absence of such great changes can be ascertained, and that such knowledge is most necessary to the proper understanding and prosperity of our greatest fishery. Moreover, the fascinating possibility that such a great change might be prophesied was held forth. In this article another problem, equally great and equally interesting is dealt with, and its close relationship to the great problems of biology is remarked upon.

Our sardine fishery, important as it is, has for the most part arisen within the last few years. At first an adjunct to that very recent one for the albacore, it has now reversed this relationship, and whereas once in Southern California the sardine was canned between albacore seasons, now the albacore and tuna are canned between sardine seasons. Such a limited experience has not until the present brought into question some of the fundamental facts upon which canning operations must rest. One of these is the subject of this paper; namely, the size of sardine which a cannery at Monterey, or a cannery at San Diego may expect to pack in the future. Will it can "quarter-oils," or "half-pound ovals"—the small fish or the large?

Experience thus far seems to indicate that the small fish will predominate to the south, the large fish to the north, that San Diego will be best for "quarter-oils" and Monterey for the larger sizes. This is an important fact—if fact it is—and if brief experience indicates the truth. Such a condition is highly probable, as any fisheries expert should know, for there are several fisheries in which such a distribution of sizes holds permanently. The cousin of the sardine—the Atlantic herring—has just such a distribution in the North Sea and along the Norwegian coast, and the Pacific herring may have the same along our own shores. The albacore of California has a similar difference in size between its southern and northern representatives. Yet we have had such a brief experience with the sardine of our waters that the seeming difference may be due merely to the passing at different times of dominating age classes such as we dealt with in the last article. Not until we know the real cause, or positive facts which will limit our

*"Quarter-oils" are the sardines packed in small square cans in oil. "Half-pound" ovals are the larger size of fish packed in oval cans containing a half pound each.

conjectures, may we be reasonably sure of the truth. So little attention has been given to the basic laws of fishery science that what we have to say about the question is necessarily speculative—but will, we hope, demonstrate the possibilities and the fascination of its solution.

Inevitably the theory most popular and most readily advanced to explain the differences in sizes is that of *migration*. According to this the sardines move towards the north as they grow older, and then the eggs are carried to the south by currents, so that there is a manner of eddy in existence. Perhaps some people would unhesitatingly assert that sardines hatch from the egg near San Diego and reach the State of Washington before they die. The more moderate minded would possibly confine themselves to a migration of the distance between San Diego and San Pedro. But it is worthy of note that either is a pure assumption, which must bear critical examination no matter what the degree of limitation imposed upon the theory.

It presupposes, indeed, that the sardine population is a homogeneous one, necessarily of the same race or breed from north to south. The proof of the existence of peculiarities in the fish from San Diego which are not present in the fish from San Pedro or Monterey, even though these peculiarities are not racial nor inheritable, would decidedly limit the theory of migration, if it did not eliminate it. The existence of such local "races" of herrings has been conclusively shown, to the great damage of the theory in the case, but it persists in modified form—that the herring of each local race migrate in the same way as all were supposed to do. And so it will doubtless be in the case of the sardine, the proof of the existence of local races will simply confine within smaller limits the ever-present theory. Nevertheless, it is of the greatest importance to distinguish local races of the sardine if possible.

But aside from this attempt to confine within logical bounds a theory tending to be adopted in a most unscientific way, there should also be examined certain fundamental facts which may bear on the question. Thus he supposed migration must vary enormously from year to year to account for the great schools which appear off Alaska, if indeed it could be shown that such schools could be drawn from the south without producing there a great temporary lack easily noticeable. And, again, it is an open question whether there is anything approaching the requisite permanent lack of adults in the south or the lack of young in the north. It may be totally unnecessary to postulate a migration, as a matter of fact, for sufficient adults or young may be present everywhere throughout the range of the species. Moreover, when one considers the vast numbers of eggs laid by fishes, like to the seeds of trees, and the few which must come to maturity from all that horde, it would seem perfectly obvious that even a slight difference in the surrounding conditions would cause great changes in the numbers which reach the various sizes, or stages of growth. And in this last possibility, we come to the second—perhaps more logical theory that differences in proportion of adults and young may be due to the *differences in living conditions.*

For living conditions must play among fish much the same part that they do among the human kind. Scientists have shown that in barbaric races of man the prevalence of disease, hunger, and war tend to reduce

the chances of survival and render the older inhabitants relatively fewer than in quieter communities. So we might expect among fishes, that if other animals preyed on the earlier ages, the proportion of adults would be much reduced. And it is perhaps a significant fact that the sardines farthest south live in waters which are populated with many active and predacious enemies, particularly of the mackerel type, such as the tuna and the albacore. The contrast between north and south is, indeed, obvious to anyone who has fished in both waters. What more natural, then, than the failure of the young fish in southern waters to survive in numbers to adulthood, despite those favorable conditions for hatching the eggs which these waters may afford?

And it is equally logical that in the far north the chances of survival after once hatching are much better. A great percentage may grow to maturity and increase very greatly the numbers of adult fish, and with them the average of the size. Naturalists have often commented on the fact that the species in colder waters although fewer in number each consist of vastly more individuals, than in warmer waters. Perhaps the difference in rate of mortality explains this—certainly it appears to harmonize with conditions in the sardine.

But if the colder northern waters with fewer enemies allow fish to survive after hatching, are the natural conditions as friendly to the floating egg? One might venture to surmise not, judging from what facts are known. For it has been in northern waters that the vast variation in the success of spawning seasons has been noticed. A favorable year may allow myriads of eggs to hatch, while five, ten or more years may elapse without a recurrence of such favorable conditions. So the phenomenon of a dominating year class arises, concerning which we wrote in the last article in CALIFORNIA FISH AND GAME cited above. This phenomenon has been noticed only in northern waters in such species as the herring and the cod. It seems to occur in our northern sardine, as witness the appearance of the great schools in British Columbia during the last few years. So perhaps we may find that the abundance of large sardines in our northern waters depends, first on the only occasional success of a spawning season, and then on the growth of a large part of the resulting young to maturity. Such an hypothesis seems to fit the facts, and explain the sudden great extension to the north of a commercial abundance of sardines.

If, however, we go far enough to the south, say to Monterey, we may find a region where there is both a reasonable chance of spawning successfully, and a comparatively low rate of mortality still. Then—like nations under similar conditions—the average age of the population would be high, and the young somewhat scarce among the many adults. But even there we might find in a modified degree the phenomenon of dominating age classes, making the sardine appear to be smaller or larger in average size at times. So some such conditions may yet be found at Monterey.

Thus this second theory must be borne in mind, that conditions of existence may lead to varying kinds of populations. To the south, as at San Diego, the numerous young fish may find it hard to survive to maturity, to the extreme north the eggs may not develop save under favorable conditions recurring but seldom, and midway the adults may be more abundant because the young are able to survive the less numer-

ous enemies. The hypothesis certainly harmonizes with the facts as we imperfectly know them. Yet other theories may fit these facts nearly as well.

For if surrounding conditions can modify the actual numbers of fish of various sizes, it is equally probable that they can modify their appearance in the commercial catch. There is no greater fallacy extant, it seems to us, than the assumption that the fishermen catch a fair, or even a passably fair, representation of what actually exists in the ocean. It remains to be proved in every case that a fisherman with his gear, or—what is far more dubious—a scientist with his apparatus, can take a fair sample of any species or of any group of species. So for the third theory we may have one that is perhaps somewhat comforting to the commercially interested man: namely, that the *difference in sizes is really an illusion.*

It is common knowledge that in the method of fishing many things vary from day to day. To some fisheries more or less smooth water is necessary for successful operations. Or market conditions may change and shift the demand from one class of fish to another. Or on one part of the coast fish are taken by one method and on another a different one is used, perhaps merely because of the nationality of the fishermen. So, great caution is necessary that careful investigation of the fisherman and his methods is made at the same time that the fish is studied.

These things are comparatively easily discounted, but there is another category of circumstances not as readily investigated, namely, the effect of physical conditions, such as temperature or currents, upon the accessibility of the fish. There may be, for instance, many adult sardines at San Diego, but oceanic conditions may be such that they are simply never seen, never appear to the fishermen. And the great run of large fish in the far north may not be due to the unusual abundance of some year's spawning, but simply to the prevalence of unusual conditions which may serve to bring the fish in. Or an adult fish may react differently to temperature conditions, as is true of the albacore in a certain degree, and the change in temperature, however slight, may have a decisive effect in preventing the appearance of the large fish or of any particular class, save under the most favorable conditions. Or perhaps the varying salinity of the superficial layers of water may have a decisive influence, as is supposed to be the case in some parts of the North Sea. So there are many things which might be surmised to have an effect on the abundance of fish, so many and in truth so obvious, that fishermen are very prone to adopt this theory. Yet it is very easy to underestimate the ability of the fisherman to take the fish, and very easy to overestimate the sensitiveness of the fish to such changes as occur. Careful observation should be able to decide as to the probability of such occurrences as are mentioned in this paragraph, and to test the real presence or absence of the fish.

To the average casual reader these theories must be confusing, and decision between them very difficult. But there is, indeed, every logical reason to believe that the phenomena which must result from any of these possibilities would vary in a manner clearly distinguishing them according to their origin. Thus the appearance of the large fish far to the north may be due to the dominance of one year class

resulting from one spawning, or it may be due to favorable conditions bringing in the schools toward shore. But nothing should be easier to the scientist with a knowledge of methods of reading age from the scales than to decide whether the fish that come in are really made up of one great year class. That is simply an illustration of one of the possible methods of scientific attack, resultant from close observation and knowledge. So many are they that we may reasonably hope to solve most of the tangled problems that lie before us.

These are problems which are not merely of importance commercially but bear intimately on some of the greater problems of biological science. The true distribution of a species, for instance, may be seen to be in question, and the inadequacy of delimiting such distributions from collections of isolated individuals should be plain. We are in truth studying the factors which limit the distribution of a species, a subject still unknown, despite its importance to the student of the origin of species, or the nature of species. There seems to be no more favorable method of approaching these great problems of biology than through the study of the vast mass of data which the commercial fisheries place at our disposal. They are problems which involve a knowledge of great numbers of individuals and of the actual effect which conditions have on those numbers. The study is statistical if you please, is of commercial value, too; but still is scientific, and biological.

WHALES AND SARDINES.

By Will F. Thompson.

It has recently been the writer's fate to meet several times the argument advanced in all seriousness that the killing off of the whales and the albacore leave a surplus of sardines which might as well be used as fertilizer. This argument for the presence of a surplus is untenable, as is well known by fisheries scientists. Many arguments more valid may be cited leading to an opposite conclusion.

In the first place such animals as the whale, the albacore or tuna perhaps consume more enemies of the sardine than they do of the sardine itself. These fish, such as the anchovies, the mackerels, red cod, etc., probably feed on the young, as well as on the adult sardine. The anchovy, for instance, has a beautiful straining apparatus in its gills with which it might remove the eggs and larvæ from the water to swallow them. And the sardine eggs and young float freely in the open sea for such fish to take. These small things are so delicate that they must be destroyed immediately and no method of ascertaining the amount consumed is at hand. It is, on the other hand, easy to satisfy one's self about the sardines such fish as mackerel consume. So the existence of the whale and albacore may be actually a benefit to the sardine fishery, and their destruction a disaster to the industry.

A classic case could be found in Alaska, where the numbers of herring should supposedly be increased by the practical extinction of the halibut, which consumes the herring in quantities. But careful investigation of the halibut food showed conclusively that it ate more enemies of the herring than it did of the herring. It ate gray cod,

long-jaw flounders, dog-fish, rat fish, red cod and black cod, each as often as it did herring—and every one of those species is a bitter enemy of the herring.

Similar cases of mistaken conclusions as to the harmfulness of birds may be found. For many birds eat injurious insects to an extent that far overbalances any harm the birds themselves do to crops. The same is perhaps true of the whale and the albacore.

In so far as the albacore is concerned, an endeavor on the part of the writer to investigate its food met with disaster. For it was soon found that the fishermen were using sardines, anchovies and other fish for bait, or to chum the fish, and that the albacore which were caught had naturally a great many such bait fish in their stomachs. The same applies to the salmon. But, indeed, even ignoring this fact, it was found that such things as squids, small crustacea, and fish of other species formed a large part, at times all of the food of the albacore, tunas and salmons.

Another argument just as valid as that in support of the theory of the surplus of sardines is available. For it is common knowledge that the whale eats even more anchovies than it does sardines, and the anchovies may make serious inroads on the food supply of the sardine, being nearly the same type of feeder. Therefore the destruction of the anchovies must be advantageous, and the whale a benefactor, indeed.

The point to what has been said, we would emphasize, is the positive fact that nature is exceedingly complex, and that those who come to ready and easy conclusions are inevitably wrong. We do not wish to assert in an unqualified way that we are correct in saying that the destruction of any such animals as the whale, the albacore, the tuna and such animals is a disaster to the sardine, but we do wish to assert that the balance is just as likely to go that way as the other, and probably does. And that would be the case were all the suppositions advanced above untrue.

And as a matter of fact, if such great numbers of albacore, of of tuna and of whales have been taken, it may be high time to propose some protection for them.

The argument that there is now a surplus of sardines is a strange one to meet at this time. If we had three vessels at sea in a storm and two of them were sunk, would we talk confidently about the safety of the other? Yet that is just what is happening. The great salmon fisheries of the Alaskan and British Columbian coasts are on the verge of extinction, as everyone now knows, despite the fact that years ago statements that the supply was inexhaustible were quoted just as freely as they are now about the sardine. And the same is true of the halibut fisheries to a still greater extent. As in those two fisheries, once the two greatest on our coast, disaster has come, so may we well watch vigilantly lest disaster come to another great fishery, that for the sardine. Abstract speculation on intricate things such as the effect of killing off the enemies of the sardine is worse than useless in the face of real experience.

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All material for publication should be sent to H. C. Bryant, Museum of Vertebrate Zoology, Berkeley, Cal.

MAY 6, 1921.

PEOPLE AND THE LAW.

People obey the laws because they believe them wise and just—not merely because the laws happen to be.

That fish, or that game law serves best its purpose which is based on real conditions, exact needs and which operates without undue injury to any person or class.—Adapted from *Pascal*.

THE 1918-1920 BIENNIAL REPORT.

The usual biennial review of the work of the Fish and Game Commission has appeared in a striking green cover with a colored reproduction of the Loch Leven trout. The report, which contains 150 pages, deals with the work of the various departments and is abundantly illustrated with photographs showing the work and accomplishments of the Commission. A comparison of this volume with the first report issued in 1870 furnishes an interesting contrast and proves that during fifty years of service to the state there has been great improvement in organization and in results.

In the introductory pages a tribute is paid to the men who so creditably served their country during the world war and a page is devoted to six employees who have died during the past two years.

Outstanding features of the biennial period have been the rearing and planting of 34,000,000 trout fry, the greatest number ever planted by the Commission in its history in a like period. In addition approximately 29,000,000 Chinook salmon were distributed in the Sacramento, Klamath and Eel rivers. The new Tahoe Hatchery with four times the capacity of the old one is described and figured.

The number of arrests and amount of fines assessed on offenders during the biennial period is the greatest in the history of the Commission—1,891 arrests and $49,426 in fines.

The Commercial Fisheries Department reports wonderful progress in connection with the gathering of fisheries statistics and the solving of many problems relating to the fisheries. Several graphs vividly show the growth of the different fishing industries and the output of the canneries.

Among the legislative recommendations in the report are a shortened trout season and a one buck limit on deer.

The educational and publicity campaign beginning in 1914 has been successfully continued. Particularly noticeable results have been obtained in the schools and in the summer resorts of the state.

NEW FISH BULLETINS.

There are now ready for distribution two new fish bulletins. Bulletin No. 4 is entitled, "The edible clams, mussels and scallops of California," and is the result of research made by Professor F. W. Weymouth, of Stanford University. The bulletin contains seventy-five pages, nineteen plates and twenty-six figures. The author notes that there were two purposes in issuing it. "First, it is an attempt to estimate the economic importance to the state of the bivalves here treated by putting on record the extent and position of the available mollusk producing grounds, the number and abundance of the edible species, and, by contributing to a knowledge of their life histories, lay the foundation for such protective legislation as may in the future be found necessary. Secondly, it proposes to make available to the camper and amateur naturalist a means of identifying the more common and important bivalves." Perhaps the most attractive feature of the bulletin is a key well illustrated which should be usable by the amateur in identifying any of the species of mollusks found in the state.

Fish Bulletin No. 5 is entitled, "A key to the families of marine fishes of the West Coast," and appears under the authorship of Professor E. C. Starks, of Stanford University. The key has been tested out by the students of Stanford University and should be of value to any one in the identification of fish which fall into their hands.

FISHCULTURAL METHODS UPHELD.

A recent newspaper attack on the methods and accomplishments of the fish-cultural department has brought forth many protests. Resolutions and letters in large quantity have been received from sportsmen's clubs, chambers of commerce, forest supervisors, boards of supervisors, and private individuals pointing out the successes attained in planting trout. Among the sportsmen's clubs defending the present methods are the Sierra Rod and Gun Club, the Grass Valley Sportsmen's Club, Lindsay Fish and Game Protective Association, El Dorado County Rod and Gun Club, Caspar Rod and Gun Club, Fresno Sportsmen's Club, Yuba County Fish and Game Association, and the Alturas Sportsmen's Club.

All unite in pointing out that in order to keep up the supply of trout where there is heavy fishing, it is essential to stock the streams annually. Many point out that had not annual plants been made the streams would now be barren of fish life. Fortunately, the opposite condition exists, owing to fishcultural operations.

Mr. C. J. Walters, of Independence, states that streams that are extensively fished have increased wonderfully since the planting of fry began. According to Robert E. Eddy, Secretary of the Lindsay Fish and Game Protective Association, it is the unanimous testimony of our members who know the streams and of ranchers in the mountains, "that fish are now being taken from places formerly barren, since planting began regularly in this section." George A. Green, President of the El Dorado Rod and Gun Club, writes: "Prior to 1910 no eastern brook trout had ever been taken from the American River, the fish life being entirely limited to the rainbow trout. In 1910, our club received from the Fish and Game Commission some eastern brook trout fry. These were planted in the American River near Kyburz. We have received and planted some eastern brook fry every season since. Today fifty per cent of the trout taken from the American River between Riverton and Phillips Station are eastern brook trout. The same holds good in regard to all other streams in our country."

All of the communications report satisfactory results and state that the fry are received in uniformly good condition. The one complaint evidenced is that individuals and organizations are unable to secure as many fish as they desire for planting purposes.

IN MEMORIAM—FRANK SHOOK.

It is to be regretted that deputy Frank Shook, one of the oldest and most loyal deputies in the employ of the Commission, died on January 16, 1921, at his home in Salinas.

From the time of his appointment as deputy, on November 15, 1907, Frank Shook was one of the most sincere workers of this Commission. He was always on duty and always gave the best service possible. He not only knew the violator and his ways, but he knew thoroughly Monterey County, the country which he patrolled, and it is because of the fact that he possessed all of the many qualities that are so necessary in one entrusted with the enforcement of the law that he was so valued and trusted as an employee of the Commission. That his loyal service was appreciated by the Fish and Game Commission goes without saying.—J. S. H.

THE NATIONAL GAME CONFERENCE.

The annual National Game Conference under the auspices of the American Game Protective Association was held in New York City on January 24 and 25. For the first time, the California Fish and Game Commission was represented at this conference. Dr. H. C. Bryant was able to attend, owing to a lecture program regarding nature guide work which was made possible by Mr. Stephen T. Mather, Director of the National Parks. Dr. Bryant gave an illustrated lecture on the subject, "Education as part of the conservation program," in which the work of the California Fish and Game Commission was outlined; emphasis being placed on the work in the schools and in the summer resorts. At the banquet, the last night of the conference, motion pictures showing wildfowl on Lake Merritt, California's first game refuge, were shown and received very favorable comment.

Outstanding features of the program were the discussions on a federal license,

to take the form of a stamp which can be pasted on the state license, and on the need for a treaty with neighboring countries relative to migratory fishes to supplement the one relative to birds, which is already in existence.

Considerable interest was also displayed in the report of the Virginia Fish and Game Commissioner regarding a law to control the vagrant dog. The law which is administered by the Fish and Game Commission has been effective in the destruction of 30,000 vagrant dogs since its enactment. That any state should have a dog problem, as well as a cat problem, was a surprise to those attending the conference.

A large number of resolutions relative to the conservation of game were passed.

THE STEELHEAD, A DISTINCT SPECIES.

The exact status of the steelhead trout has long been a mooted question. Although for many years considered specifically distinct, it has in more recent years been considered a sea run form of the rainbow. The United States Bureau of Fisheries now announces (Bureau of Fisheries Document No. 896, pp. 6-7) that Dr. W. C. Kendall, scientific assistant and ichthyologist, is bringing to completion a report which it is believed will settle the much discussed question of the specific identity or distinctness of the rainbow and steelhead trouts.

"After a careful study of the fish from taxonomical, anatomical, and distributional evidence the conclusion is reached that there are at least two wild forms which have been confused under the names of rainbow and steelhead trouts. One is predominantly migratory (ascending fresh waters from the sea), the other predominantly a permanent fresh water inhabitant. The name *Salmo irideus* was originally bestowed upon a small steelhead form, as was also *Salmo rivularis*. There is absolutely no doubt concerning the proper application of *Salmo gairdnerii* to the steelhead, as Richardson's description is that of a large Columbia River fish and not a small blueback salmon (*Oncorhynchus nerka*), as one writer has stated. Contrary to current descriptions, the steelhead has larger (fewer) scales than the rainbow, and there appear to be other though inconspicuous and concealed structural differences.

There is probably more than one species or race of rainbow trout, and possibly also of steelhead. However, the rainbow trout of fish culture is largely from McCloud River (California) stock and should bear the name, not *Salmo irideus*, but *Salmo shasta*. The fishcultural rainbow stock has been more or less affected by admixture of another form principally from Klamath River, which may be another form or species of rainbow or perhaps a steelhead. This admixture is clearly perceived in the appearance and structure of many specimens of the rainbow stock of some of the hatcheries. The steelhead stock has always, so far as known, been unadulterated *Salmo gairdnerii*, although in the distribution from hatcheries it is known that in some instances the two forms have been regarded as identical and distributed as rainbow trout. Pure *Salmo shasta* is distinguished from pure *Salmo gairdnerii* by the smaller scales of the former."

SALMON DESTROYED ON SPAWNING BEDS.

Because of the law which allows of the taking of three salmon by means of a spear, in districts one and two, between September 25 and November 15, many salmon are being destroyed on the spawning beds in Shasta and Siskiyou counties. Aliens, as in other cases, are the greatest violators. They often build a sort of trap across a stream and working at night spear the fish as they move through a narrow entrance to the trap. As many of the fish are unfit for food, because on the spawning grounds, these violators sometimes kill as many as from fifteen to twenty fish and save but the three that they are allowed by law. The deputies of the Commission have difficulty in apprehending these violators because they work at night and because they are not to be found with more than the legal limit in their possession. Fortunately, sentiment in these counties is changing and many now see the danger in allowing salmon to be taken by means of a spear during the spawning season. It is to be hoped that there will be sufficient sentiment to make possible a change in the law during the present session of the legislature.

BLUE JAY HUNT IN SAN BENITO COUNTY.

Several years ago blue jay hunts were in vogue, but more recently little attention has been paid to the bird accused by the sportsmen of destroying quail's eggs. Of late, however, a well organized blue jay hunt was held at Hollister, California. Sixty sportsmen were divided into two rival teams and a week chosen for the hunt. When the final count of birds was made at the end of the week the total showed 1531 blue jays. One team outdistanced the other by 210 birds and this winning team were the guests at a big barbecue held by the other team. One hunter bagged 233, and the second best was 139.

FIG. 38. The result of a blue jay hunt at Hollister, California. An organized blue jay hunt by sportsmen of the region netted 1531 blue jays in one week.

Whether such organized blue jay hunts are beneficial to the interests of game and other birds is still doubtful. That the blue jay deserves to be placed on the black list few will deny, but that blue jays good and bad, and there are good blue jays, should be killed off in large numbers is a question. Whether blue jays are actually as destructive to quail as to tree nesting birds is also something that still has to be proved. Doubtless, many arguments can be given on both sides, and the thing which is needed is more evidence. When those engaged in such a hunt spend as much energy in trying to determine the food of the blue jay as they do in making a large kill of birds a solution of the problem will be forthcoming.

MORE FINES FOR HUNTING OUT OF SEASON.

Apprehended for shooting four pintail ducks out of season, a Missouri hunter on March 7, 1921, was fined $200 and costs by Federal Judge Van Valkenburg, sitting at St. Joseph, Missouri. This sentence follows closely upon the conviction of a hunter in New Jersey before a federal judge by whom he was fined $200 and costs and sentenced to jail for ten days.

The spring flight of migratory birds is at its height during April, and the Biological Survey of the United States Department of Agriculture is putting forth every effort to see that they are permitted to go north to their nesting grounds unmolested. Due to the active cooperation of federal game wardens and state authorities, fewer violations of the federal law are occurring this spring than formerly. Nevertheless, some unscrupulous hunters are taking a chance; arrests for shooting out of season are being made by the game wardens and convictions are being obtained in nearly all cases.

MORE AND BETTER FUR.

"The demand for fur is far greater than can be met. Evidently the time is at hand when steps should be taken to increase and improve the fur supply. Trappers, dealers, manufacturers, and wearers, possessing in the aggregate a tremendous moral and financial influence, want more and better fur.

"Among the bad practices which have reduced the number of fur bearers are: (1) Using poison, which kills many animals that are not found before their skins are spoiled; (2) smoking animals out of their dens, which often suffocates them instead of forcing them out; (3) destroying dens, which either leaves the animals without suitable places in which to rear their young or drives them out of the neighborhood altogether; (4) trapping early in fall, which catches animals having small, unprime pelts before they are old enough to be suspicious of traps; and (5) trapping late in spring, which destroys breeding females with young.

"If no early or late trapping were done there would be fewer animals taken, but on the other hand the value of the catch and the number of animals left to breed another season would be far greater. Skins are prime for about two months after the molt is completed, and during this time they have no dark spots on the flesh side. They are worth much more when prime (. . . .) than when unprime (. . . .). Muskrat and beaver pelts are best in February and March, while those of other fur bearers are best from late in November till about the end of January."—Yrbk. U. S. Dept. Agri. 1919, Separate 823.

RAINBOW TROUT IN HAWAII.

In the Fisheries Service Bulletin, No. 69, issued February 1, 1921, Mr. H. L. Kelly, a former assistant of the Bureau of Fisheries and now the executive officer of the Fish and Game Commission of the Territory of Hawaii, gives an interesting report on the rainbow trout resulting from eggs supplied by the Bureau of Fisheries in 1919. Before making an application for another shipment of eggs to be hatched and planted on government reserves, Mr. Kelly went to Kauai to determine how the trout planted in the streams of the island were thriving. He found the people enthusiastic over the species and in the streams which had been stocked many trout were seen. Some of the fish were caught. The largest measured 7¾ inches and others 5¼ inches. These were taken exactly six months after planting. Requests were made for plantings in the mountain streams of the islands of Molokai and Maui. Their beautiful coloration and rapid rate of growth are prime factors in the success of the importation experiment to the sportsman and the fishculturist alike of Hawaii.

A DECLINE IN THE CONSUMPTION OF FISH.

"How are we to meet the decline in the consumption of fish and the resultant hardship on the fishing industry of the United States?"—is the question of the United States Bureau of Fisheries. During the period of the war the consumption of fishery products grew to considerable extent, which resulted in an expansion of facilities for the capture, preservation and marketing of these products. Despite the more adequate facilities for supply and the general advancing costs of materials and labor, there was a decline in the fishing industry.

Not only on the eastern coast is this the case but it would appear to be true to a certain extent in the west as well, as is demonstrated by a graph published in the 1920 Biennial Report of the California Fish and Game Commission giving a comparison of fish of all kinds packed in northern and southern California. A slight decline in the total number of cases of fish packed is shown by the following figures:

	1918	1919
Southern	1,385,202	1,166,435
Northern	729,100	905,206
Total	2,114,302	2,071,641

1918	2,114,302
1919	2,071,641
	42,661

However, in California, the salmon, and particularly the sardine catch, has steadily increased, as stated for the period 1917-1919, yet the estimated 1920 pack of canned salmon in the United States,

including Alaska, is about 3½ million cases less than in 1917 and includes about 2½ million cases of the cheaper grades (pink and chum), which it is reported are being offered for sale for less than the cost of production and can be sold with profit by the retailer at a low price. The canners of sardines and the cheaper grades of tuna are confronted with similar difficulties.

The problem is indeed one of importance, for aside from the fact that fish is our cheapest and best source of natural food supply the fishermen are, most of them, small, individual producers with little or no training for a change of livelihood and these men will suffer, if the industry is allowed thus to decline.

accidents during the open season, as well as being a conservation measure. In 1917, twenty-eight fatal hunting accidents occurred in Michigan and Wisconsin. Out of this total, twenty-two occurred in Michigan as against only six in Wisconsin. The reason for the disparity was again laid to the fact that bucks only were allowed to be killed by deer hunters in Wisconsin, while in Michigan the big game hunters were allowed to kill without waiting to see the horns.

And so it continues to be demonstrated that the buck law in California and other states is largely responsible for the reduction in the number of hunting accidents.

FIG. 39. Fishing on the north fork of the Feather River. The trout season opened April 1, as usual. Photograph by F. A. Farnum.

BUCK LAW DECREASES HUNTING ACCIDENTS IN NEW YORK.

Quoting from the Conservationist for December, 1920: "The deer hunting season of 1920 closed with only one fatality due to a man being shot in mistake for a deer. Last year there were nine deaths from this cause, during a season when both bucks and does could be legally shot. Restoration of the buck law, and the requirement that a hunter look for horns before he shoots, is unquestionably to be thanked for the low mortality this year."

The buck law is one of the prime factors in reducing the number of hunting

A CONSERVATION READER FOR CALIFORNIA PUBLIC SCHOOLS.

"The wave of enthusiasm for the conservation of our natural resources must reach the children or it will expend much of its force uselessly." With this end in view, H. W. Fairbanks of Berkeley, California, who is the author of many text books on geography, has written a Conservation Reader.* The book brings out in a simple and interesting manner the principles of conservation. After introductory chapters giving a contrast be-

*Fairbanks, H. W., 1920. Conservation Reader (World Book Co., N. Y.) VI, 216 pages, illustrated.

tween the past and the present, the conservation of soils, water, trees, forests, wild flowers, coal, oil, gas, aquatic animals, and birds, is outlined. The book is illustrated with two colored plates furnished by the National Association of Audubon Societies and with various reproductions of photographs.

"The movement for the preservation of natural resources can succeed only with the establishment of an enlightened public sentiment on the subject. To create and maintain such a sentiment is the proper work of the schools." The use of this conservation reader in the schools should help greatly in developing the right attitude toward natural resources and the consequent attainment of proper conservation of them.

PRESIDENT HARDING IN SYMPATHY WITH WILD LIFE CONSERVATION.

Mr. T. G. Pearson, President of the National Association of Audubon Societies, in answer to a telegram, received the following telegram from President Harding, who was at the time President-elect.

"I am fully in favor of a policy which will guard the integrity of our national parks and our bird reservations. I favor the enforcement of our treaty with Canada for the protection of valuable migratory birds. Please accept my greetings to your Association." (Signed)

WARREN G. HARDING.

Those who are interested in our national parks and in the conservation of our wild life take great satisfaction in the expressed attitude of President Harding.

FUR-BEARERS PROTECTED IN TRINITY REFUGE.

Game Refuge No. 1-D has been closed to trapping except for coyotes, mountain lions and bobcats. This restriction will bring about the same object with reference to fur-bearers as that attained for deer. The refuge is an ideal one for this purpose and if the law can be enforced and the predatory animals exterminated, it is absolutely certain that these species will be preserved forever, and that to a large degree the overflow can be legitimately trapped. Similar provisions for preserving fur-bearers should be applied to other refuges.—E. V. Jotter, Weaverville, California.

THE FUR SUPPLY AND ITS MAINTENANCE.

Mr. Ned Dearborn, Assistant Biologist, Bureau of Biological Survey, has recently written a pamphlet entitled "Maintenance of the Fur Supply."* In introducing the subject of his paper he says, "to direct attention to the great commercial importance of fur; to emphasize the need of maintaining the supply, which lately has been declining at an alarming rate; and to point out ways by which this supply may not only be maintained as to quantity but improved as to quality, is the purpose of this circular.

"The subject is discussed from the viewpoint of the farmer, to whom fur-bearing animals, if rightly managed, will be a source of interest and profit."

"The commercial history of America begins with fur, and from the early days down to the present this has been an important article in our domestic and foreign trade."

The World War has changed the center of the world fur trade from Europe to the United States, and the center of manufacture in the United States is New York City or the near vicinity. The United States has learned the art of dressing and dyeing the skins, as is demonstrated by the drop of forty per cent in the ratio of dressed and raw skins imported into the country. In 1914, dressed skins imported were worth $3,500,000, while raw skins imported were worth $7,500,000. In 1919, $4,000,000 worth of dressed skins were imported, as against $69,000,000 worth of raw skins.

"A concrete example of the rise in fur prices is afforded by the actual record of one man's fur-lined overcoat. This coat, lined with mink, in 1913 cost $500. After wearing the coat two years the owner sold the mink lining for $1,000 and replaced it with nutria at a cost of $150. Two years later, in 1917, he had the nutria lining removed and sold it for $250. A muskrat lining was then put in the coat at a cost of $55, which, in 1919, was in turn removed and sold for $300. The original purchaser still has the shell."

Although the price of furs is bound to drop to a certain extent, the fur dealers are not uneasy. The use of fur is being

*U. S. Dept. Agric., Dept. Circ. 135, Nov., 1920.

widely exploited—is being advertised for summer use as well as for winter—yet, there are two important factors to be reckoned with: (1) About one-half of the skins disposed of at American auction sales are of foreign origin. (2) The supply of furs is waning to the extent that if the present condition should continue for a few years the supply in settled districts would come to an end.

The following remedies for the situation are pointed out by Mr. Dearborn:

(1) All trappers should be licensed at a nominal fee and at the end of the trapping season should turn in a complete report of the skins taken. This report to be published for the benefit of the public.

(2) Farmers should be made to appreciate the possibilities of this source of income. They should know that although most of the important small fur-bearers are carniverous, few of them are destroyers of poultry. "Among fur animals, as among men, the proportion of criminals is small." Skunk-proof poultry yards should be installed, and the subsequent value of enticing the skunk to the farmer's land to destroy the rodents advocated.

Further emphasis should be placed on this natural source of income to the farmer, from animals which he neither has to feed nor shelter, so long as he recognizes the value of preserving their dens and killing them with discretion.

(3) The wisdom of killing fur-bearers only when the peltries are prime is forcefully brought out to the farmer by the associative argument, namely, that it is just as short-sighted for the farmer or trapper to kill fur-bearers before the peltries are prime as it is to harvest crops before they are ripe or when they are overripe. Hence, the value of limiting the trapping to a two months open season which is believed to be the most effective and efficient means of obtaining results.

(4) The importance of having fur animal preserves and of domesticating the animals is of moment. Now that the characters of North American animals and their geographical distribution are well known, the production of superior fur should be much more possible.

(5) Animal dens should be protected, and the knowledge of the local attachment of animals used to good advantage. The use of poison, smoke, gas, or fumes in taking fur-bearing animals should be prohibited.

Mr. Dearborn's paper is of importance to Californians for he points out that in this state the asset value of wild fur-bearers to the people of the state has been estimated at $7,125,000. The annual catch of fur in the state brings about four per cent of this huge sum. "By proper conservation it might readily be doubled." Therefore, the value of encouraging and promoting the fur industry along the right channels at this embryonic period in its development would seem most advantageous.

CAMP SANITATION.

Are you going camping this summer? The mountains of California constitute one of the most delightful of recreation areas, and an outing there may be most healthful and enjoyable if proper use is made of the opportunities offered. Proper use means, in a very important degree, good sanitation. If you take an outing you will find that your pleasure is marred when you discover evidences of careless habits of other campers. Remember that you are one of many thousands of campers that go to the mountains during a season, and that all have a right to expect you to avoid defiling the pleasure ground that is theirs as well as yours. Remember ,too, that these mountains are the catchment areas for drinking water supplies of many thousands of people and that the purity of these supplies depends very largely upon the efforts of yourself and other campers to practice intelligent sanitation.

The principles of good mountain sanitation are simple and their practice is not more burdensome than maintaining customary cleanliness around home. At home the person of common decency does not tolerate an accumulation in his yard of cans, bottles, papers, garbage and fecal matter, yet why is it that one may frequently see an otherwise attractive spot in the mountains littered with these things? Is it because the camp ground

is only a temporary stopping place and campers lack the neighborliness to clean up their own refuse out of kindness for those who follow? Is it that same return-to-nature, otherwise carelessness, that on a camping expedition contents a man to go a week or two without a shave? It is thoughtlessness, and carelessness, perhaps laziness, but no part of nature.

The principles of good mountain sanitation are simple. Burn or bury all refuse and use care not to contaminate streams. There you have a complete program for keeping our recreation areas clean. Take a small shovel and some matches with you on your camping trip and use them with prudence. They will be useful for other than sanitary purposes.

When you build your camp fire burn your waste paper and when the meal is finished burn your garbage. Bury these materials if you do not have a camp fire; don't leave them for the next fellow to dispose of. Bury also your unburnable refuse, such as cans and bottles, or throw them into the underbrush well out of sight. Practice the ordinary principles of good housekeeping.

"Leave your camp as you would like to find it. Keep the pleasure grounds of America clean."—California State Board of Health.

NEW YORK'S ANNUAL GAME DIVIDEND.

Beginning in 1919 all owners of hunting licenses in the State of New York were required to report the game killed for the preceding year. The statistics compiled show that there were reported 465,590 cottontail rabbits; ducks taking a fifth place in the kill showing a total of 109,663; male deer totaled 8,293. The grand total of game taken in 1918 was 1,526,960.

The game and fur-bearing animals of New York State, if capitalized, are worth not less than $53,000,000; they return an annual dividend of more than $3,200,000; and they cost the state for their protection and increase the nominal sum of $182,000. This cost of protection and increase is thus less than six per cent of the annual dividend.

FACTS OF CURRENT INTEREST.

In 1920, Trinity County spent $1,323 in controlling the coyote. A bounty of $3 each was paid on 441 coyotes on which the reward was claimed.

Salmon have appeared early this season, 150 pounds having been taken by trawling near the Farallones on March 3, 1921. In 1919 and 1920 the first salmon were caught after the middle of March.

Although some of the ayu eggs imported from Japan hatched, they were so weakened by fungus that none of them survived.

Deputies Carpenter and Britton arrested two men at Arbuckle during March who had in their machine 184 ducks. They were presumably on their way to San Francisco to dispose of this illegal game. Both men were taken before Justice Jones at Williams, who sentenced them to sixty and ninety days, respectively, in the county jail.

A bill before the legislature provides for a limit of ten abalones per day. This would effectively prohibit the commercialization of this sea food.

Large shipments of edible crabs have been arriving in San Francisco. On March 12, 1921, a shipment amounting to four truckloads was received.

No less than three bills which would abolish the present Fish and Game Commission have been introduced in the legislature. Two of them would make fish and game work depend upon appropriations by the legislature.

HATCHERY NOTES.

W. H. SHEBLEY, Editor.

SEASON PROSPECTS.

As outlined in the January number of CALIFORNIA FISH AND GAME, the past season was a very successful one from the standpoint of the number of trout fry reared, the quality of the fish planted and the systematic manner in which they were distributed, when the difficulties encountered in the prosecution of the work, due to the extreme drought, are taken into consideration.

Plans are under way for still further improvements in the fish distribution work during the coming season. Within the next two weeks all applicants, who received trout fry last season, will be sent application blanks and will be requested to file their applications prior to the thirtieth day of April. Judging from recent correspondence with many of last season's applicants, there is going to be an unprecedented demand for trout fry this coming season. This is due to several reasons. There were very few losses of fish last season. The success of fish planting during the past few seasons due to our closer cooperation with the applicants and to sending of special messengers, trained in fish planting work, to assist and instruct in the best methods of handling and planting the fry is beginning to show more satisfactory results and the public is coming more generally to realize that it is only by extensive restocking of their fishing streams and lakes each year, that they may prevent depletion due to excessive fishing.

Public association of anglers, resort owners and individuals, who are interested in one way or another in fishing, are taking more interest in the work, as the efficiency of our methods is demonstrated to them. Then to, Boards of Supervisors, Chambers of Commerce and public officials, having the business interests of their communities at heart, are coming to realize that fish and game are among the best assets to a community, and that it is only by keeping the streams stocked with trout fry from the state hatcheries that the depletion of the fish in the streams and lakes can be avoided. They therefore consider, from a business standpoint, that appropriations of adequate amounts from their funds to provide for proper distribution of the fish allotted to them by the Commission is money well spent.

During the past several years of drought, it has been extremely difficult for us to obtain a sufficient number of trout eggs to supply all of the fry required to adequately stock the waters of the state, despite the rapid increase in the extent of our operations. This season we hope to materially increase our output of trout fry. No effort has been spared to make the coming season the most productive of results that we have ever had. The older egg-collecting stations have been enlarged and improved to handle a greater output and hatcheries have been equipped to take care of all of the eggs which it is possible to secure.

The new Lake Tahoe Hatchery, as previously mentioned, has been finished and is ready for occupancy. The Mount Tallac Hatchery will be opened as usual about the middle of March and in addition to the egg-collecting operations, which have been carried on in past years at the mouth of Taylor Creek, a new egg-collecting station will be operated on the upper Truckee River.

Arrangements are being made to establish an experimental hatchery near Blairsden, in Plumas County, to take care of the requirements of the Feather River district, as well as the North Yuba River district near Sierra City. If this station can be successfully established, it will eliminate to a very great extent, the necessity of transporting trout fry for stocking the streams in Plumas County from the Mount Shasta Hatchery. This long haul is very hard on the fish and is very expensive. If rainbow trout can be successfully reared at the Feather River, near Blairsden, which is centrally located, they can be distributed to far better advantage and with much less expense than to ship them from so great a distance as Sisson.

By the establishment of this hatchery that section of the Yuba River in the vicinity of Sierra City can be handled to better advantage, as the long haul from Sisson to Nevada City and thence by auto

: over the heavy grades along the
ı River will be eliminated.

erations at the Mount Shasta Hatch-
nd the various egg-collecting stations
; the Klamath River are in full swing,
e it is too early in the season to state
itely the number of eggs, which we
expect from the Klamath River sta-
. we have every reason to believe that
take will be very satisfactory. The
of the rainbow trout are "running"
logrs Creek, Camp Creek and Fall
k and something over a million of eggs
been taken to date. The run of fish
ottonwood Creek is somewhat later,
indications are for a successful take
ggs at the Hornbrook Station. The
on fry which are being hatched at Mount Shasta and Fall Creek hatcheries are doing nicely and will furnish a fine lot of fry for distribution this spring and for placing in the large salmon rearing lakes where they are held throughout the summer months and then liberated in the upper reaches of the Sacramento and Klamath rivers next fall.

Steelhead egg-collecting operations are under way at the Scott Creek and Snow Mountain collecting stations and indications are that a successful take of eggs at both places will be secured.

Ukiah Hatchery is in readiness for the reception of the steelhead eggs from the Snow Mountain Station.

Brookdale Hatchery is also open and prepared for operations. Extensive re-

FIG. 40. Copco Dam on the Klamath River. This dam is so high that a fish ladder was not feasible. Consequently, the California-Oregon Power Company was compelled to build a fish hatchery in lieu of a fishway. Photograph by C. Westerfeld.

pairs to the water supply system have been made and the station generally is in first class condition. Over three-quarters of a million of steelhead eggs have been taken at the Scott Creek Station to date and are being cared for at Brookdale. A half million salmon fry are being reared at the Fort Seward Hatchery for distribution this spring in Eel River, Mad River and tributaries of Humboldt Bay. The hatchery is all ready for the reception of steelhead trout eggs from Ukiah Hatchery.

Domingo Springs, Almanor and Clear Creek hatcheries will be open for operations during the middle and latter part of March.

A crew of fishculturists will be sent into the Big Bear Lake district within the next two weeks and operations will be commenced as soon as the fish start "running" at the North Creek Station.

The Kaweah Hatchery will open for operations shortly after the first of April.

Wawona Hatchery will, as usual, be opened sometime during April.

The San Joaquin River Experimental Station is still in operation. The weather has been extremely cold, the water being close to the freezing point for days at a time and development of the salmon eggs has been very greatly retarded.

Three hundred thousand Loch Leven trout eggs were shipped during the latter part of December to the Mount Whitney Hatchery and the resulting fry are doing nicely. Everything at this station is in readiness for the commencement of the season's operations. The seasonal work on the grounds has been progressing nicely and the gardens promise to be in even better shape than they were last season.

COMMERCIAL FISHERY NOTES.

N. B. Scofield, Editor.

SHALL WE USE FOOD FISH FOR FERTILIZER?

With a poor market for canned fishery products and a strong market for fertilizer and poultry foods, a difficult problem confronts the Fish and Game Commission and the state legislature. Canneries at Monterey and in southern California are asking for permits to catch sardines in quantity for use at reduction plants rather than for use in the canneries. So great is the demand made by the canneries that a bill has been introduced into the legislature which would allow the use of food fishes for fertilizer and poultry products. Up to this time, only ten to twenty per cent of the catch, which was considered as "overcatch," has been utilized in the reduction plants. It is feared that the sardine has already suffered from over fishing, owing to the great demand of the past few years, and that a further toll levied would deplete the supply. Present plans to continue fishing obviates the chance of the species to recuperate and assure an abundance of fish in the future.

In order to test the present law which allows only the spoiled fish and the overcatch to be utilized in the reduction plants, cannery men of southern California have instituted a test case which is now before the courts.

FISHERIES, 1920.

During the year 1920 there were 208,342,816 pounds of fresh fish and 6,423,911 pounds of mollusks and crustaceans, making a grand total of 214,766,727 pounds of fishery products, taken in the waters of this state. The catch for 1920 shows considerable decrease in the totals in comparison with the catch for 1919 which was 262,258,511 pounds. The sardine catch showed the greatest decrease, which was approximately 35,000,000 pounds less than during 1919. Salmon, yellowtail, sole, squid and clams also declined, while the catch of albacore showed an increase of about 5,000,000 pounds.

The decreased catch of sardines was on account of the poor demand for the canned and salted products and canneries did not operate their plants to full capacity during the year and many of those plants operating closed down early in the fall. During the spring of 1919 there were great quantities of sardines used in reduction plants for fish meal. In the summer of 1919, a law went into effect preventing the use of edible fish in reduction plants and during 1920 there was no straight fishing for sardines for reduction purposes.

The salmon catch in the state shows a decrease of approximately two million pounds, the total catch for the year being 11,138,693 pounds. Along the coast north of San Francisco the catch was about the same as the previous year, some particular localities showing slight increase, while other districts show a small decrease. The decrease in the catch was on Monterey Bay and the Sacramento River. The Monterey Bay catch was 1,300,000 pounds less than in 1919, which was by no means a good year for that district. The Sacramento River catch declined about 700,000 pounds. The water was very low in the Sacramento River during August and September and no doubt this fact, together with the poor quality of salmon and low price, had considerable effect on the catch as a number of the fishermen laid up their boats and stopped fishing some time before the season closed on September 24.

During 1920 there were 1,941,984 cases of fish canned. Of this amount, 1,062,996 cases were sardines and 835,645 cases were tuna, these two varieties of fish being the principal fish used for canning purposes in this state. The tuna pack for 1920 was greater than during the previous year, while the sardine pack was lighter. The total pack of all varieties canned in 1920 was about 130,000 cases less than during 1919.

Complete statistics of the fisheries for the year 1920 will be published at a later date and should show some very interesting data.—S. H. D.

SACRAMENTO RIVER SALMON MARKING, 1920.

When salmon hatching on a large scale began on this coast it was the custom to liberate the fry in the streams as soon as the yolk sacks had been absorbed. Of late years the fry have been held for longer periods of time at the hatcheries on the belief that larger fish are better able to take care of themselves when liberated in the streams. The small fry in the hatchery troughs are of necessity crowded and are accustomed to being fed at regular intervals. It is thought that planting these small fry in a stream is too sudden a change and that too many fall a prey to enemies before they learn to avoid dangers and forage for themselves. To overcome this difficulty the small fry are transferred from the crowded hatchery trough to a large pond or lake where they have more room and are often able to find some natural food. From the pond the fry may be transferred to the stream when they are considered to be of sufficient size or when the height of water in the stream is considered most favorable.

Proof of the relative success of different times of liberating has been lacking, partially due to the difficulty of securing data. One method of securing this proof is to mark some of the young fish from two or more lots of fry liberated at different times. A comparison of the number from each lot recovered when they return to spawn would throw some light on the success of the different methods of liberating. The great difficulty in all such marking experiments is that so few marked fish are recovered. In the cleaning sheds large numbers of fish must be prepared for market in a short time and the fish are handled so rapidly that the missing fins of marked fish are either not noticed or are neglected, so that time is not taken to measure the fish, to take a sample of the scales and send the data to the office of the Fish and Game Commission. It is impractical to have a representative of the Commission at all of the fish sheds while fish are being received.

Another difficulty is the possible objection to marking fish by the removal of fins or with metal tags in that one is never sure that the behavior of such marked fish is typical of the behavior of unmarked fish of the same brood. Nevertheless some valuable data may be secured from such marking experiments. No other method has yet been devised for securing knowledge of the migrations of salmon in the ocean. In this connection, the first article in the January, 1921, number of this magazine is of special interest in showing that marked fish liberated in the Sacramento River were recovered not only in the Sacramento gill nets but also by trolling at such widely separated points as Monterey and Shelter Cove.

At a conference (September 8, 1920) between representatives of the California Fish and Game Commission it was de-

cided to try another King salmon marking experiment using Sacramento River eggs and liberating in the Sacramento. The object of the experiment was threefold, first, to contribute to the knowledge of ocean migrations and, second, to throw some light on scale readings by comparing the hatchery lake growth with the normal stream growth. The third and chief object was the comparison of three methods of liberating fry: liberating (1) large fry in the fall, (2) yearlings in the spring, and (3) small fry in the spring. To accomplish this it was planned to mark three batches of fish corresponding to the three enumerated above. Of the first two batches of fry from November, 1919, eggs, the first was to be marked and liberated in September, 1920, and the second in the spring of 1921. The third, from the fall of 1920 eggs, to be marked and liberated in the spring of 1921.

The first batch was marked as planned but the remainder of the experiment was unexpectedly upset by the behavior of the Sacramento River. These marked fish were to have been liberated sometime in November of 1920, but the fall floods of the Sacramento broke levees and it was feared that too great a loss of young fry would result if the liberation were made during the time of floods, so it was necessary to hold the fish over winter. However, the marking already completed should contribute something toward determining ocean migrations and possibly scale growth characteristics. The following is an account of the marking of the first batch of salmon fry.

Source of Eggs and Hatching.

The King or Chinook salmon eggs were taken by the United States Bureau of Fisheries at its substation on Mill Creek, a tributary of the Sacramento River, Tehama County, California. The eggs were taken the latter part of November, 1919, eyed at Mill Creek and sent in a shipment of 1,258,000 to Sisson, California, where they were received February 10, 1920. They were hatched the latter part of February at the Mount Shasta Hatchery, a state hatchery at Sisson. After several weeks in the troughs the fry were transferred on May 27, 1920, to Klink's Lake, one of the three lakes at the hatchery used for holding fry before the final planting in the stream. Here they remained till the end of September when part of them were returned to the hatchery for the purpose of marking.

Size of Fry.

These fry in the latter part of September, 1920, were ten months old reckoning from the time the eggs were collected or seven months from the time of hatching and had spent four months in Klink's Lake. A sample of 120 of these fish taken at random on September 27 showed an average length of 7.9 centimeters, or 3.1 inches. The greatest extremes in length of fish from this sample were 5.8 to 10.8 centimeters, or 2.3 to 4.25 inches. Other extreme cases were found where the range was from 4.5 to 13.0 centimeters, or 1.8 to 5.1 inches. The measurements were made from the tip of the nose to the tip of the central rays of the tail fin.

Mark and Number Marked.

The mark used was the removal of the adipose fin and the posterior half of the dorsal fin by clipping with cuticle nippers. Twenty thousand fry were marked, the marking being started on September 25 and finished on October 4, 1920. The marking was done by C. L. Frame of the Department of Fish Culture and W. L. Scofield of the Departmentof Commercial Fisheries.—W. L. SCOFIELD.

A NEW SPECIES OF FISH FROM SANTA CATALINA ISLAND.

A specimen secured from the Avalon Aquarium has been described as a new species by Carl L. Hubbs, of the Museum of Zoology, of the University of Michigan.* This new fish is of particular interest because it has been named for Mr. William Francis Thompson, in charge of the State Fisheries Laboratory, of the California Fish and Game Commission, who is the author of many important works on marine fishes.

Sciaena thompsoni is most similar to three Panamaic species, but has fewer dorsal fin-rays and longer caudal peduncle, as well as other differences.

*Hubbs, Carl L. 1921. Description of a new Sciænoid fish from Santa Catalina Island, California. Occ. papers Museum of Zoology. No. 92, pp. 1–3, 1 pl.

BARBLESS FISH HOOKS.

Certain sportsmen's angling clubs are advocating the use of barbless hooks for catching fish, arguing that it is more sportsmanlike for it gives the fish a chance for its life. Besides its being a more creditable performance, they say, to catch fish with a barbless hook, the undersized fish when returned to the water will be more apt to survive as they are hurt very little.

It is interesting to note here that the commercial fishermen in fishing for long-finned tuna, skipjack and bonito in southern California use principally barbless hooks. The motive in their case is not to give the fish a better chance for their life, but to enable them to catch them faster, for the barbless hook is more quickly extracted and time is thus saved when the fish are coming fast.

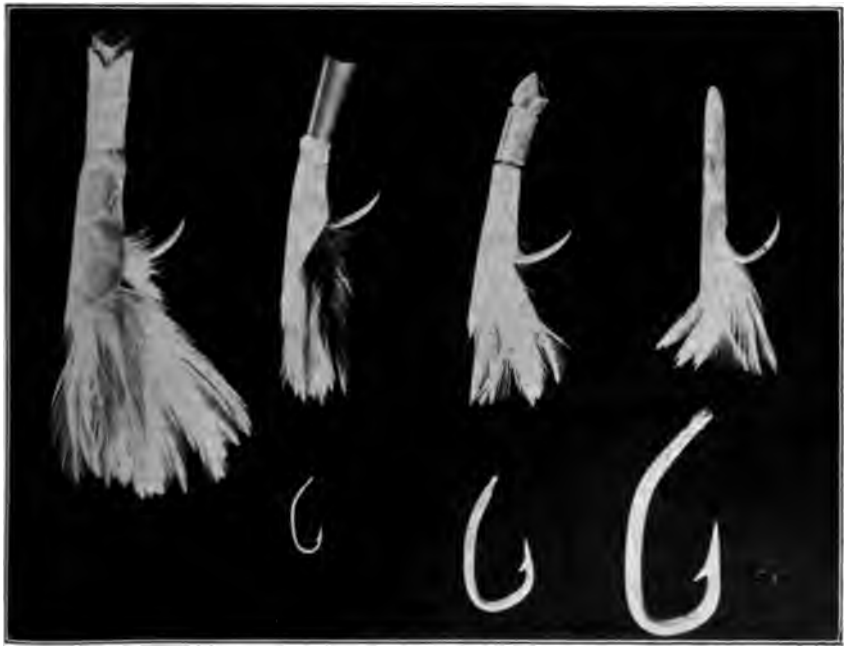

FIG. 41. Barbless hooks used in the capture of tuna. Photograph by H. C. Bryant.

LIFE HISTORY NOTES.

THE PORCUPINE AS FOOD.

An animal, purely a vegetarian, that plays great havoc with gardens all through this country, is the porcupine. Sometimes, all of the garden stuff on outlying ranches in this section is completely destroyed by this pest. One of our rangers trapped a good many porcupines in his garden at a ranger station last summer, and he and his family used them to a considerable extent as food. I have eaten porcupine meat on several occasions during the past summer and found it to be quite palatable. Only for the fact that the meat is coarser in texture, one could imagine he was eating beef -provided of course, that the porcupine is young. An old porcupine is the toughest chewing imaginable -WM. S. BROWN, *Alturas, California.*

TREE SQUIRRELS INFESTED WITH SCABIES.

A dead California gray squirrel (*Sciurus griseus griseus*) was recently sent to the University of California by Deputy Euell Gray from Placerville, California, for post mortem, as it was afflicted with a disease which has been killing off great numbers of gray squirrels in the El Dorado National Forest. The disease was first noticed among the squirrels on the Georgetown Ridge in 1917. The gray squirrels were practically exterminated in this district. Since then, the disease has spread from this vicinity and is now most noticeable in the southeastern part of the county.

The first evidence of the disease is to be seen in a scaly or mangy appearance around the head and neck. This is followed by sores over the rest of the body and the hair falls off. Dead squirrels are to be found at the bases of trees and in streams of water.

Examination, by the veterinary and entomological departments of the University of California of the specimen sent in showed the disease to be a form of scabies. According to Professor Stanley B. Freeborn, the cause is to be found in a mite belonging to the genus *Notoedres*. These mites live in little tunnels dug in the skin and they eventually cause bad sores which weaken the animal to such an extent that death finally ensues. A closely related species found on the cat has recently been transmitted to the rabbit, horse, dog and man, always with difficulty and with no serious effect. Laboratory rabbits infested with a similar species of mite invariably die a more or less lingering death, if left untreated. Thorough washing followed by applications of sulphur ointment repeated three or four times, at intervals of five or six days, generally produces satisfactory cures in these animals, if taken early.

It is to be hoped that this epidemic will disappear, as do most epidemics of this kind.—H. C. BRYANT, *Berkeley, Calif.*

ANTELOPE SHOW INCREASE.

Prong-horn antelope (*Antilocapra americana*) near Mount Dome in Butte Creek Valley appear to be on the increase. Mr. Crawford, of Yreka, recently counted 108 animals near Mount Dome. This is an increase of sixteen head over the last count of these antelope. This increase is apparently due to the careful enforcement of the law which gives total protection to the antelope—J. O. MILLER, *Yreka, California.*

REPORTS.

SEIZURES—FISH AND GAME; ILLEGALLY USED FISHING APPARATUS.

Game.		
Deer meat	141	pounds
Quail	253	
Ducks	797	
Doves—pigeons	9	
Rabbits—squirrels	2	
Pheasants	3	
Swan	1	
Mudhens	18	
Miscellaneous birds	80	
Deer hides	1	
Fish.		
Striped bass	617	pounds
Halibut	1,000	pounds
Salmon	3,031	pounds
Young smelt	415	pounds
Trout	8	
Crabs	2,164	
Crab meat	30	pounds
Abalones	37	
Clams—Pismo	101	
Clams—cockle	232	pounds
Lobsters	811	
Illegal nets	9	
Searches.		
Illegal fish and game	9	

VIOLATIONS OF FISH AND GAME LAWS.

October 1, 1920, to December 31, 1920.

Game.

Offense	Number of arrests	Fines imposed
Hunting without license	47	$853 00
Hunting on posted grounds	4	130 00
Trapping without license	2	35 00
Deer—closed season—killing or possession	13	625 00
Does—spike bucks—fawns—killing or possession	4	225 00
Illegal deer hides	2	30 00
Brush rabbits—squirrels—closed season—killing or possession	5	150 00
Quail—closed season—excess limit—killing or possession	35	1,048 00
Doves—closed season—killing or possession	1	25 00
Ducks—excess limit—closed season—killing or possession	14	480 00
Mudhens—closed season—killing or possession	3	75 00
Wild pheasants—swan—closed season—killing or possession	6	275 00
Non-game birds—killing or possession	33	660 00
Protected shore birds—killing or possession	15	400 00
Bear—closed season—killing or possession	2	20 00
Shooting from power boat	8	35 00
Night hunting	17	550 00
Destroying state evidence	1	30 00
Total game violations	212	$5,646 00

Fish.

Angling without license	6	$150 00
Fishing for profit without license	2	20 00
Clams—undersized—excess limit—taking or possession	16	375 00
Crabs—undersized—taking or possession	4	95 00
Abalones—undersized—excess limit—taking or possession	4	100 00
Lobsters—undersized—excess limit—taking or possession	10	170 00
Striped bass—under weight—offering for sale closed season—excess limit	6	140 00
Halibut—excess limit	1	50 00
Selling steelhead not properly tagged	1	75 00
Young fish—taking or possession	3	60 00
Fishing in restricted waters	1	
Illegal nets in restricted districts	6	200 00
Total fish violations	60	$1,435 00
Grand total fish and game violations	272	$7,081 00

CALIFORNIA FRESH FISHERY PRODUCTS FOR MONTHS OF OCTOBER, NOVEMBER, DECEMBER, 1920.

Compiled by Fish and Game Commission, Department of Commercial Fisheries.

Species of fish	Del Norte, Humboldt	Mendocino, Sonoma, Lake	Marin	Solano, Yolo	Sacramento, San Joaquin	Contra Costa, Alameda	San Francisco, San Mateo	Santa Cruz	Monterey	San Luis Obispo, Santa Barbara, Ventura	Los Angeles	Orange	San Diego	Total	Mexican
Albacore											96,633		993	97,626	
Anchovies			60				20,350		96,681				14,170	130,661	
Barracuda								3,573	22,610	78,716	298,008	251	32,943	436,101	1,530,931
Bluefish								36	15,531					15,567	
Boccaccio							10,186	72,326	291,278					373,790	
Bonito								41	36	11,924	287,260		20,060	319,321	54,584
Carp				147	1,296	6,686								8,129	
Catfish		7,881		3,986		5,950								17,817	
Chilipepper								33,438	150,813					184,251	
Cultus cod	30						51,005	11,199	63,878					126,112	
Eels												180		180	
Flounders	406		44	583		3,451	15,877	875	640		554			22,430	
Grayfish						65	20,950	1,375	710		15,389	234	89,507	128,230	
Hake							58,057							58,057	
Halibut							1,242	38	285	27,463	175,427	2,036	38,564	245,055	574,468
Hardhead					197	270								467	
Herring	739		17,239			2,020	28,040							48,038	
Kingfish							671	18,814	11,500		57,257	672	1,520	90,434	48
Mackerel								2,175	123,404	6,406	688,247	7,248	12,713	835,193	10,824
Perch	4,302		15,648			3	22,653	1,000	1,005	41	10,708	1,119	1,995	58,474	4,950
Pike				42	433	1,994								2,469	
Pompano							459		51		7,705			8,215	
Rock bass										9	35,618	1,254	10,518	47,399	1,980
Rockfish	1,016						102,982	85,403	178,517	5,172	235,294	4,394	242,090	854,868	10,932
Sablefish							181,692							181,692	
Salmon	331,459		94	17,542		12,877	21		39					362,031	
Sand dabs							46,590	12,444	90		1,781			60,905	
Sardines						200	424,985	3,122,554	20,415,121		69,116		158,981	24,190,957	
Sculpin											12,629	95	2,195	14,919	
Sea bass—black										743	14,458		3,823	19,019	24,112
Sea bass—white			15,892				3,253	11,360	629	28,778	60,228	1,134	2,733	124,007	31,740
Sea trout							24						42	66	

Shad				78		755								833	
Shad—buck						88								88	
Sheepshead										86	1,773		2,067	3,894	
Skates							19,095		140		87			19,322	
Skipjack								84			730,775	77	588,409	1,319,345	
Smelt	7,467		8,537			320	3,842	1,391	26,806	6,444	50,608	93,298	7,895	201,677	13,002
Sole	33						594,119	237,756	1,161		10,764		947	844,780	580
Splittail					798	644								1,442	
Striped bass			24	9,782		91,609	1,873							103,288	
Stingaree													1,485	1,485	
Suckers					551									551	
Swordfish											2,598		370	2,968	
Tomcod							4,450	480						4,930	
Trout—steelhead	1,089													1,089	
Tuna											243,267	35	585,911	829,213	25,908
Tuna—bluefin											6,070			6,070	
Tuna—yellowfin											1,081,522			1,081,522	
Turbot			334											334	
Whitebait			542											542	
Whitefish											2,607	150	1,165	3,923	435
Yellowtail										991	994,762	1,668	182,790	1,180,206	96,935
Miscellaneous	851		6				10,234	31,448	4,194	46,297	8,433	581		102,044	
Total fish	347,392	7,881	53,410	32,160	3 275	126,932	1,622,650	3,647,810	21,404,607	213,069	5,144,567	114,416	2,008,856	34,722,025	2,381,374
Crustaceans—															
Crabs (doz.)	39		169				11,692	7						11,907	
Shrimps							73,697				681			74,378	
Spiny lobsters										29,584	98,079	3,077	33,565	159,305	281,878
Mollusks—															
Abalones									182,852	40,435				223,287	28,355
Clams—cockle	140		1,812											1,952	
Clams—mixed	5,355	36	6,719			804								12,914	
Clams—Pismo								75		52,139				52,214	
Clams—softshell			4,440			54,607	17,065							76,112	
Cuttlefish							1,572	130	6,483		17			8,202	
Mussels						76	288	125						489	
Oysters—															
Eastern (No.)			255,537				1,390,947							1,646,484	
Native			1,905											1,905	
Snails											60			60	
Squid									440		110			550	

All amounts shown in pounds unless otherwise specified.

STATEMENT OF EXPENDITURES.

Period from July 1, 1920, to January 31, 1921.

Administration:		
Commissioners	$ 310 68	
Executive offices	14,870 58	
Printing	3,259 87	
Research and publicity	3,533 79	
Accident and death claims	1,179 53	
		$23,154 45
Commercial fish culture and conservation:		
Superintendence	8,737 52	
Inspection and patrol	17,803 38	
Research	18,096 36	
Statistics	5,778 17	
Market fishing license commissions	299 50	
Propagation and distribution of salmon	16,748 52	
		$67,463 45
Sporting fish culture and conservation:		
Superintendence	9,137 87	
Printing	172 04	
Prosecutions and allowances	212 50	
Angling license commissions	11,734 60	
Fish exhibits	4,293 19	
General patrol—pro rata share:		
San Francisco District (40 per cent)	22,457 19	
Los Angeles District (40 per cent)	9,566 74	
Sacramento District (40 per cent)	16,842 10	
Propagation and distribution of trout	94,031 27	
		$168,447 50
Game conservation:		
Printing	199 83	
Prosecutions and allowances	957 98	
Hunting license commissions	18,078 90	
Mountain lion hunting (and bounties)	4,842 58	
General patrol—pro rata share:		
San Francisco District (60 per cent)	33,553 68	
Los Angeles District (60 per cent)	14,259 67	
Sacramento District (60 per cent)	25,259 98	
		$97,152 62
Tahoe camping ground		402 11
Grand total		$356,620 13

CALIFORNIA FISH AND GAME

"CONSERVATION OF WILD LIFE THROUGH EDUCATION"

Volume 7 SACRAMENTO, JULY, 1921 Number 3

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CALIFORNIA HAWKS: HOW TO IDENTIFY THEM.

By Harold C. Bryant.

From being the most maligned of all birds, the hawks and owls are now coming to be recognized as among the most helpful to mankind. Members of this group have been continually persecuted because a few species have shown themselves to be destructive to domesticated birds and mammals. Each hawk and owl has been judged by circumstantial evidence, and prejudice has caused the good to suffer with the bad.

In recent years, the farmer has come to a realization of the great damage caused by ground squirrels, gophers and other rodents and he

is willing that all the natural enemies of these pests should be encouraged. As a consequence, state laws protect the beneficial species of hawks and blacklist the destructive ones. Nevertheless, a beneficial hawk hanging on a roadside fence or tacked to the side of a barn is still a too prevalent sight. With the exact data on food habits that we now possess, there is no excuse for ignorance as to the economic value of each species.

In the hope of stimulating interest in the preservation of the beneficial raptores the following analysis of the destructive and beneficial hawks has been made, together with a field key, which, it is hoped, will make identification possible.

BIRDS OF PREY.

Birds of prey are recognized by strongly hooked bills with a soft skin, the "cere," surrounding the nostrils, and by the large strong feet with flexible toe joints, and long, curved, sharp talons which are powerful weapons for grasping and killing prey. Of particular use are the latter in holding the prey while it is torn to pieces. In the vultures, which are carrion feeders, the talons are not so well developed. All have a swift, sure flight. Their whole structure betokens "strength, activity, ferocity, and predatory nature." Although the above anatomical characteristics are held in common by all the raptores, yet a close study shows that the different species are grouped together because of like habits rather than because of like structure.

Hawks fly by day, and in the economy of nature owls take their place at night. The owls may be distinguished by their eyes being directed forward and by the disks of radiating feathers which surround the eyes. They are among the few birds which have binocular instead of monocular vision. Hawks have less fluffy plumage and smaller heads than owls.

The hawks are slow breeders, most of them laying but two eggs each season and rearing but one brood each year. The young grow very slowly and remain in the nest for a considerable period of time before developing the powers of flight.

Identification of hawks is oftentimes made difficult because the same species frequently has two color phases. Blackish or melanistic forms are of frequent occurence in several species of beneficial hawks. Since dark colored birds do not appear among the destructive bird eating hawks, it is safe to say that all black hawks are useful. Another means of discriminating between good and bad hawks is to be found in the seasonal occurrence; the destructive hawks are almost invariably winter visitants, consequently, the chances are that hawks shot in the summer are beneficial ones.

As a rule the sexes are colored alike. There is, however, a marked difference in size, the female being the larger. The fluffy juvenile plumage makes the young bird appear larger than the adult.

The food is made up chiefly of rodents and insects, and the birds gorge themselves whenever opportunity offers. Although the flesh is often picked from the bones, small animals are usually swallowed whole. Indigestible parts are often regurgitated in the form of pel-

SHARP-SHINNED HAWK

(Right Hand Figure, Immature Female; Left Hand Figure, Adult Male)

Order—Raptores
Genus—Accipiter
Family—Falconidæ
Species—Velox

National Association of Audubon Societies

lets. The hair, bones, and other elements in a pellet can be identified and a comprehensive idea of the food may be obtained by a study of such pellets.

KINDS OF HAWKS.

Hawks are usually divided into four main groups: The meadow hunters, known as *harriers* (represented by but one form, the marsh hawk); the woodland hawks, known as *accipiters;* the soaring hawks, the *buteos* and eagles; and the "long winged chasing" hawks, known as *falcons.* Sometimes the carrion feeders, known as *vultures,* are included.

THE BLACKLIST.

By far the larger number of hawks are beneficial. It is, therefore, better to know the villians than to attempt to know all of the beneficial species. Attention is accordingly called to the following hawks which may properly be blacklisted. State laws give these hawks no protection.

All of the destructive species belong to the third group, the *accipiters.* All are typical bird hawks with long tails, short rounded wings, comparatively small heads, and with a rapid, darting flight. In the open their flight consists of alternate flappings and sailings. Seldom, if ever, do they give any cry. All habitually frequent wooded or brushy areas. These birds usually watch for their prey from some vantage point and dart in among the trees or brush to secure it. In the hand, they are readily identified by their short broad wings, and slender unfeathered legs and feet.

Three of the destructive species are very much alike in coloration and habits, their main difference being in size. We can, therefore, speak of three editions of the "chicken hawk." The first is the small sized "chicken hawk" known as the "sharp-shinned hawk." (See plate 1.) The second is the medium sized bird and perhaps the best known of all those attacking poultry, the Cooper hawk, sometimes called the "bullet hawk," and rightly called a "chicken hawk." An additional field character, to that of size in distinguishing the sharp-shinned from the Cooper hawk, is to be found in the shape of the tail. The tail of the sharp-shinned hawk is square-ended, whereas, that of the Cooper hawk is rounded. The third is the larger species found only in the higher mountains and in the northern part of the state, the western goshawk. All three are sometimes dubbed "blue darters" because of their manner of hunting. Very often they capture their prey in mid-air. The adult goshawk can be recognized in the open by its bluish colored back and wings and barred breast, as constrasted with the striped or streaked breast of the Cooper and sharp-shinned hawk. The young of the goshawk, however, have streaked breasts and can easily be confused with the Cooper hawk.

The food of these three hawks is made up almost entirely of birds, the larger species feeding to a considerable extent on such game birds as quail and grouse, in fact, to such an extent that the Cooper hawk is often known as the "quail hawk" and the goshawk as the "grouse hawk." The Cooper hawk often attacks pigeons and returns day after day to claim a victim. Stomach examination has shown that this hawk feeds almost wholly upon wild birds and poultry. Of all the common hawks this is the most "audacious highwayman." It preys commonly

on valley quail. In a nest of a pair of Cooper hawks in the San Jacinto mountains the remains of three chickens, a blue jay and a chipmunk were found (Grinnell and Swarth, 1913). The sharp-shinned hawk, of much smaller size, feeds upon the smaller birds, almost all of the commoner song birds falling prey to it. In the Fresno district, the birds which seem to suffer most from attacks by the sharp-shin are mockingbirds, intermediate sparrows, valley quail, and say phoebes (Tyler, 1913). This hawk dashes in and out among trees and shrubbery and often perches on larger limbs inside the foliage. It is most common about willow thickets and the trees along streams. A crashing sound as it strikes a bird in the foliage often betrays its presence and little bunches of feathers bear mute evidence of tragedies enacted. All

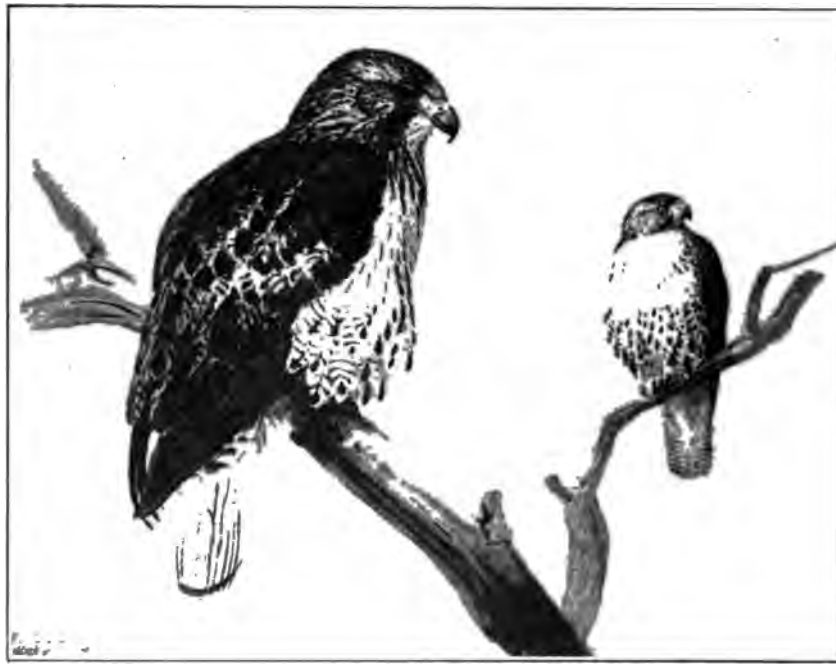

FIG. 42. Red-tailed Hawk (*Buteo borealis*). Courtesy of the United States Bureau of Biological Survey.

three species are likely to make their appearance in the chicken yard, in fact, about ninety-five times out of a hundred it is one of these three hawks which is to blame when poultry is found to have been taken by a hawk.

The duck hawk is the most powerful of the destructive species. It is a true falcon, and in Europe was considered the "noblest" of the birds used in falconry. It fearlessly attacks ducks and has even been known to attack some of the larger waterfowl. The rush of wings at it attacks its prey is said to resemble a heavy wind. Its food comprises birds, both game and nongame. Birds recorded as falling prey to the duck hawk in California are as follows: blackbirds, meadowlarks, red phalaropes, black turnstones, murrelets, auklets, ducks, doves, jays, and even sparrows. Furthermore, it is said to kill apparently for pleasure. At

any rate, it often kills more birds than it eats. Stomachs of two duck hawks from southern California, each contained the remains of a mourning dove. The short tail, pointed wings, slate-colored back, and black patches on the face should help in identifying this bird; but the general actions are still more useful in recognizing it.

The prairie falcon, much like a duck hawk in appearance, lives in the rough foothill country, nesting about cliffs, and is noted as a destroyer of ground squirrels. Although a close relative to the duck hawk, it is to be numbered among the beneficial species.

BENEFICIAL HAWKS.

The two best known beneficial hawks are the red-tailed hawk (see fig. 42) and the sparrow hawk (see fig. 43). The former is the large

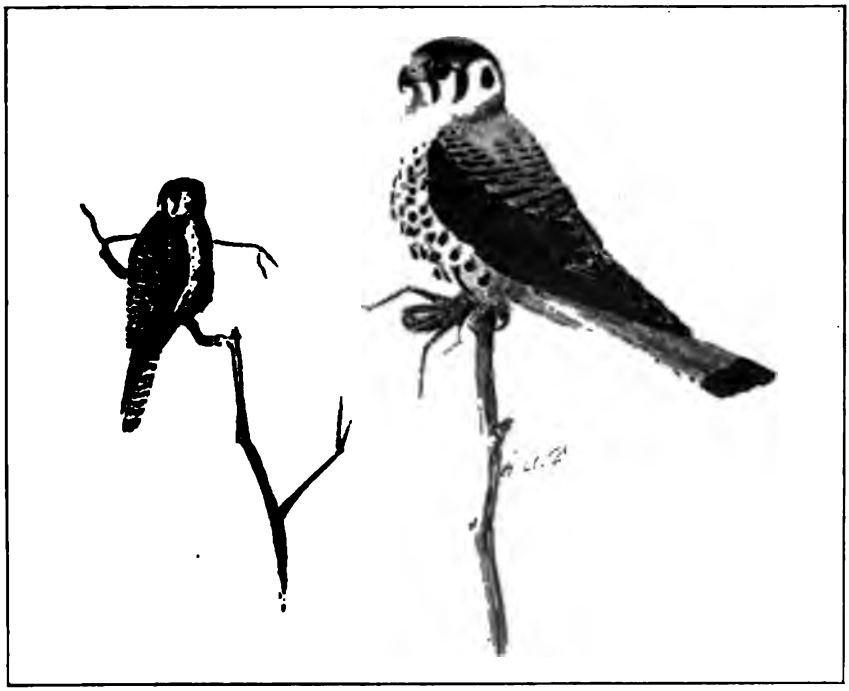

FIG. 43. Sparrow Hawk (*Falco sparverius*). Courtesy of the United States Bureau of Biological Survey.

hawk commonly misnamed "hen hawk," which is most often to be seen soaring around and around high in the air over open country, or perched conspicuously on top of a dead tree or telegraph pole. In the adult bird, the tail is reddish brown, but in the young birds the tail is barred. The common hawk call, sounding like the syllables "*pe-yare*," which so often drives poultry to cover, is given by this bird, but it very seldom bothers birds of any kind. The red-tailed hawk is a typical rodent hawk, having large clumsy feet suitable for capturing small animals on the ground. In flight also, the bird is too slow and clumsy to be successful in capturing birds. The occasional red-tail that attacks poultry

is usually a young bird, showing that the species prefers other types of food.

The food of this hawk is made up very largely of ground squirrels and mice, to which is added a goodly supply of some of the larger insects, such as crickets and grasshoppers. The stomach of a red-tailed hawk taken in the Berkeley hills contained one meadow mouse and two pairs of jaws of the common "potato bug," or "Jerusalem cricket." One red-tail taken in Los Angeles County contained a gopher; and three others were found to have been feeding on rabbits (Bryant, 1918). Over ninety per cent of the food of this hawk is made up of noxious mammals and insects. Remains of two ground squirrels were found in the nest of a pair of red-tails in San Diego County (Dixon, 1917). In nests of the red-tail remains of gophers, ground squirrels, meadow mice, a young cottontail rabbit, and two snakes—a striped racer and a gopher snake—were found (Dixon, 1906). The red-tail preys upon snakes and may often be seen carrying a snake in its talons. Stomach analyses made by the government show over eighty-five per cent of the food to be rodents.

A near relative of the red-tailed hawk is the Swainson hawk with a white throat and dark band across the breast. This is the only California hawk which develops a flocking habit. During the migration period, Swainson hawks may be seen in flocks moving leisurely across country. This bird might well be called a grasshopper hawk for it is most often to be seen capturing grasshoppers in open fields. The birds in catching grasshoppers are said to skip about in an awkward way looking as if rather ashamed of the performance. This species also feeds on mice and gophers (Tyler, 1913). This is a fairly common hawk in our great valleys.

Another relative less often seen is the ferruginous rough-leg, so called because of the feathering on the legs, which reaches to the toes. The bird, figuratively, wears boots, and this booted appearance is helpful as an identification mark, also the white underparts, often with a dark band, and the white patch at the base of the tail on each side. The rough-leg prefers open country and is often to be seen perched on the ground near squirrel burrows. This hawk, perhaps more than any other, merits the name "squirrel hawk." Meadow mice also prove tempting as food. A rough-leg taken at Cotati, Sonoma County, contained seven meadow mice (Bryant, 1913).

The rarer red-bellied hawk is a bird of the lowlands and marshes, recognized by its reddish brown breast and its mode of flight, which reminds one of that of a horned owl. This hawk feeds on caterpillars, insects and small rodents. The stomach of one bird taken near Corona, Riverside County, contained "potato bugs" (*Stenopelmatus*) and beetles, and that of another a pocket gopher (Pierce, 1919). The stomach of a third taken in Fresno County contained large hawk moth caterpillars, beetles and "potato bugs" (*Stenopelmatus*), (Bryant, 1921). In the nest of a pair of red-bellied hawks in San Diego County, was found one ground squirrel and two pocket gophers, carried there to feed the three young birds in the nest (Dixon, 1917). In another nest was found a brush rabbit, hair of a ground squirrel and an alligator lizard (Sharp, 1906). Stomach examination has shown fence lizards (Dixon, 1906), Jerusalem crickets and caterpillars.

The golden eagle (see fig. 44), although often accused of stealing farm animals and poultry, is deserving of careful protection, for its food is made up almost wholly of the larger rodents. A nest examined by J. B. Dixon in San Diego County, contained the remains of eleven ground squirrels, largely the surplus carried to the two young birds in the nest (Dixon, 1917). Rabbits and ground squirrels are the principal items of food. The notable decrease in numbers has been due to the desire

FIG. 44. Golden Eagle (*Aquila chrysaetos*). (Drawn by R Ridgway.) Courtesy of the United States Bureau of Biological Survey.

of many to kill something large, not to a desire for relief from depredations. It is particularly important that the golden eagle be left unmolested by the rancher.

The bald eagle (see fig. 45) depends so largely upon fish as a diet that it is almost invariably found along the sea coast or about large inland lakes. An occasional fawn, lamb, or pig is taken, but this eagle is primarily a fisherman. On San Clemente Island and other islands of the

Santa Barbara group, where this eagle nests, it is said to feed on sheep and lambs, as evidenced by bones near the nest (Howell, 1917).

The sparrow hawk (see fig. 43) is the smallest and usually the most common of all and is often to be seen perched on fence posts or telegraph poles. It has a cry that sounds something like the words "*killy-killy-killy-killy,*" which sometimes gives it the name of "killy" hawk. The reddish brown tail of the adult and the black bars on the face will

FIG. 45. Bald Eagle (*Haliaeetus leucocephalus*). (Drawn by R. Ridgway.) Courtesy of the United States Bureau of Biological Survey.

help in the recognition of the bird, as will also its habit of poising in the air with beating wings. The sparrow hawk develops speed and captures its prey by dashing directly after it.

From the sharp-shinned hawk the sparrow hawk is distinguished by sharp, pointed wings which are in contrast to the short, rounded wings of the former. In the hand all of the falcons may be recognized by the notch near the tip of the bill which is lacking in other hawks. Although called "sparrow" hawk, this hawk very seldom preys upon birds, preferring large insects and mice. Grasshoppers and large beetles form

the principal items of food. Tyler (1913) reports grasshoppers as the staple diet of some sparrow hawks in Fresno County.

The less common pigeon hawk is to be distinguished from the more common sparrow hawk by its darker coloration, by a blackish instead of a brown tail, and by the white throat patch. This hawk has a habit of perching humped up on conspicuous perches and when frightened flies swiftly and fairly close to the ground to another perch not far distant. The pigeon hawk does not confine itself so largely to insects as does the sparrow hawk and is guilty of preying upon small birds as well as rodents.

In lowland country the marsh hawk (see plate 2) is a familiar bird with its long wings, long narrow tail and white rump patch. It is usually to be seen flying along with leisurely strokes of the wings, about three or four feet above the ground, quartering back and forth over the meadows and marshes searching for its prey, which is comprised almost entirely of meadow mice. On the sight of a mouse the bird suddenly plunges downward and makes off with the luckless animal. The marsh hawk will occasionally help himself to a bird, or even to poultry if available. The author once saw a marsh hawk make off with a killdeer. It will be found, however, that individuals, rather than the species as a whole, are responsible for depredations of this kind. With the possible exception of the skunk, there is no animal that exerts better control on meadow mice than the marsh hawk.

Young marsh hawks are reddish brown all over, but the adult male has a whitish breast, gray back, and wings with black tips—suggestive of a gull. This is the only American hawk belonging to the *harrier* or meadow hunter group and the only hawk which nests on the ground.

The white-tailed kite, another hawk which is gull-like in appearance and which frequents the marshes, is now very rare in California and needs careful protection to save it from complete extermination. Its food habits proclaim it a beneficial hawk. The stomach of a specimen from Santa Rosa contained a meadow mouse.

The osprey, or fish hawk, is found along the sea coast and around the larger bodies of water in the interior. The white head and breast are conspicuous. This bird feeds exclusively on fish, especially such slow moving ones as carp and suckers.

The United States Department of Agriculture has pointed out that "the sooner farmers, ranchers, horticulturists, and nurserymen learn that the great majority of birds of prey are their friends, and deserve protection, the sooner will depredations of noxious rodents and insects diminish." By encouraging beneficial hawks time and effort is saved, for they automatically help control rodent and insect pests, being ever alert and ready to move to a center of infection. If given a chance, they will prove more effective than either traps or poison. Protection of hawks is the most economical pest control measure.

It must be remembered that even the so-called destructive hawks have their place in Nature, for natural enemies of birds tend to maintain within proper bounds the numbers of the species on which they prey and preserve their fitness. Many believe that the relation between the predator and the animal preyed upon is such that direct increase follows destruction of the predatory species. These same individuals maintain that on an area set aside as a refuge, increase of bird and animal life

will not be noticeable unless "vermin" be destroyed. Since in the early days abundance of game was coincident with abundance of natural enemies this contention does not seem reasonable. Rather should one understand that under natural conditions there is a certain balance struck between a species and its natural enemy and oftentimes the activities of one help to balance those of the other.

Forbush (1916) who defends the above point of view gives the following example:

"The marsh hawk (*Circus hudsonius*) feeds to some extent on marsh birds and their young, but a much larger part of its food consists of meadow mice and frogs. These mice certainly would be very destructive to young birds were they not held in check, and large frogs are known to swallow the young of water birds. Marsh hawks and other enemies prevent many frogs from reaching a size when they would be dangerous to young birds.

"If nature is undisturbed, therefore, all the birds are reared and maintained that the land will support, but when civilized man steps in and disturbs the natural arrangement and balance, then, and perhaps then only, the natural enemies of birds may become unduly destructive, and must be checked."

Rodents constitute our worst farm pests. Were it not for natural checks to their increase it would be impossible to grow crops. Field mice have from four to six litters of young a year with from two to thirteen comprising each litter. It has been estimated that one pair of meadow mice are capable of producing nearly a million young in five years. Of course, such an increase is never really possible because of natural checks, including natural enemies. To eliminate natural enemies or even reduce their number disturbs the balance and increases the numbers of the pest.

Of course, artificial means of check, such as trapping and poisoning, have been devised, but their use entails time, energy, and expense. By encouraging natural checks on the increase of rodents more can be accomplished with less expenditure of effort. Most hawks eat rodents, and herein lies the reason for their encouragement.

A FIELD KEY.

Lest the good hawks be destroyed with the bad it is necessary to distinguish friend from foe. Ability to recognize the different species of hawks is, of course, the shortest road to conservation of the beneficial and destruction of the injurious. The average person finds it difficult to name a hawk seen in the open by reference to the average bird book because the distinguishing characters given are those suitable for use with a dead bird or specimen. As an aid to identification of live birds in the open the following key of field characters is appended, a key which it will be found emphasizes quite different characters from the more familiar ones found in bird books. This key has been prepared as an experiment to determine whether keys of this kind are possible, or useful. No doubt more accurate observation would be productive of

N. B. The United States Department of Agriculture has issued several bulletins dealing with the economic value of hawks, notably the authoritative work, "Hawks and Owls of the United States," by A. K. Fisher, which may often be consulted in libraries. The value of each species is judged by the results of many stomach examinations. Another review of the value of hawks is to be found in the National Geographic Magazine, Vol. 38 (Dec., 1920), under the authorship of Louis Agassiz Fuertes.

MARSH HAWK

Order—RAPTORES
Genus—CIRCUS
Family—BUTEONIDÆ
Species—HUDSONIUS

National Association of Audubon Societies

still better field characters and in the light of later knowledge a better key devised.

The characters which must be studied in order to use the key are: mode of flight, shape or general countour, color, color markings, and habitat. Even a better character in some cases is the call, but this has not been widely used in the key because of the difficulty of conveying an idea of the call by means of syllables. Then too, some hawks are notably silent and others are heard to call only in the breeding season.

Field Key to California Hawks.

A Soaring flight; birds of open country, or large bodies of water.

B Body black or blackish brown in color.

C Head not feathered and reddish in color.

D About 30 inches in length, without white patches on underside of wings; wing tips silver gray beneath; carrion feeder_____ _____(Turkey Buzzard) TURKEY VULTURE

DD About 50 inches in length, with snow white patches on underside of wings (under wing coverts) appearing as windows when the bird is soaring overhead; carrion feeder; very rare _____ _____(Condor) CALIFORNIA VULTURE

CC Head feathered.

E Head and tail of adult white in color; bare yellowish legs; call *cac, cac, cac;* chiefly near sea or large bodies of water____BALD EAGLE

EE Head and tail of adult blackish brown; found in mountainous regions_____GOLDEN EAGLE

BB Body brownish in color; head feathered; thick set with broad rounded wings and broad spread tail.

F Less than 30 inches in length; under 4 feet wing spread.

G White patches on base of tail above; dark band separating white throat and belly; conspicuous black "wrist marks" under wing; legs feathered to base of toes; often perches on ground. (The American Rough-leg is a rare winter visitant which differs but slightly from the resident bird)_____ _____(Squirrel Hawk) FERRUGINOUS ROUGH-LEG

GG No white at base of tail; legs (tarsus) strong and unfeathered.

H Tail of adult reddish brown with whitish tip (immature birds readily confused with other Buteos); call a high pitched whistled *keee, keeee,* suggestive of the sound of escaping steam; tail spread fan-like in flight_____ (Hen Hawk; Buzzard Hawk) WESTERN RED-TAILED HAWK

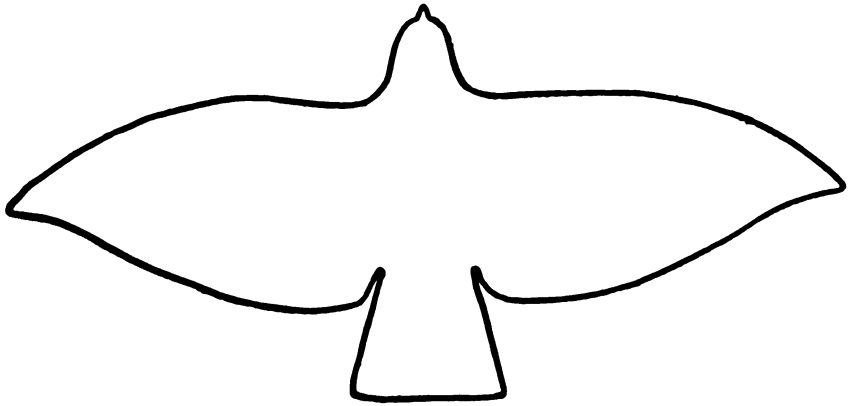

Fig. 46. Outline drawing of the red-tailed hawk, made directly from a freshly killed specimen, showing the broad type of wing usable as a recognition mark for this bird and other Buteos.

HH Tail barred with brown and breast with band of brown; forehead, chin and throat white; commonly feeds on grasshoppers; only hawk displaying flocking habit; call *pi-tick, pi-tick, pi-tick,* frequently repeated (Bailey)----------SWAINSON HAWK

HHH Tail blackish with white bars; breast and shoulders rusty red ----------RED-BELLIED HAWK

FF More than 30 inches in length; wing spread over 6 feet; base of tail white in young; legs feathered to base of toes; call, *kiah, kiah, kiah.* (Bendire) ----------GOLDEN EAGLE

BBB Body white in color except for bluish wings and black shoulder patches; gull-like in appearance; call, a plaintive, musical whistle---------- ----------WHITE-TAILED KITE

BBBB Breast and head white; black eye stripe; feeds on fish--------OSPREY

AA Owl-like flight; beating wings; tail blackish, crossed by 4 or 5 white bars; breast and shoulder rusty-red; frequents willows and trees near rivers and marshes; call, *yee-ak, yee-ak,* repeated rapidly in a high key (Bendire)-- ----------(River Hawk) RED-BELLIED HAWK

AAA Beating flight; harrier habits (alternate, measured flappings and sailings); long, pointed wings.

I Tail white; breast white; hovers; gull-like; rare--WHITE-TAILED KITE

II Tail not white; white rump patch, narrow tail as long as body; flies close to ground when hunting--------(Mouse Hawk) MARSH HAWK

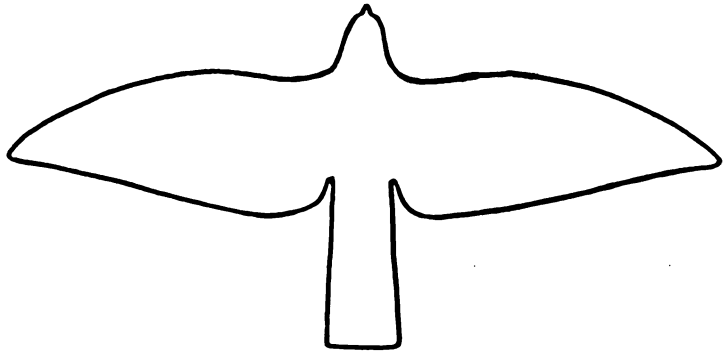

FIG. 47. Outline drawing of a marsh hawk, made from a freshly killed specimen, showing the long wings and tail which are characteristic of this hawk.

AAAA Dashing, darting pursuit flight, with alternating quick wing strokes and sailings in the open; long tail; no black markings under wings.

J Short, broad, rounded wings; barred tail; slender legs; no black bars on face; flight consisting of rapid flappings followed by a short soar; head comparatively small; seldom gives a call except when nest is disturbed.

K Length 11 to 13 inches; tail square; buoyant flight---------- ----------(Bullet Hawk) SHARP-SHINNED HAWK

KK Length 15 to 19 inches; tail rounded; impetuous flight---------- ------(Blue Darter; Quail Hawk; Chicken Hawk) COOPER HAWK

KKK Length 22 to 24 inches; top of head black; conspicuous white stripe over eye; adult with barred breast and slaty blue wings---------- ----------(Grouse Hawk) GOSHAWK

JJ Long narrow, pointed wings; black bars on face forming border to whitish throat; head comparatively large.

L Without white head.

M Length 15 to 19 inches.

N Found near water; powerful flight.....(Peregrine Falcon) DUCK HAWK

NN Found in open country of interior valleys; nests in cliffs; call a high pitched *keë, keë, keë* (Bendire).....PRAIRIE FALCON

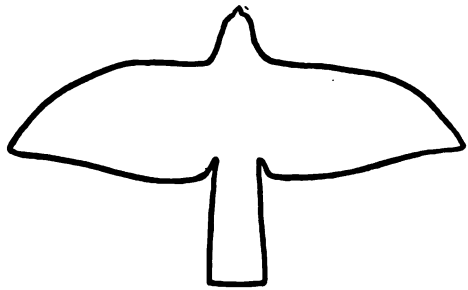

FIG. 48. Outline drawing of the sharp-shinned hawk, made directly from a freshly killed specimen, showing the short, broad wing and long tail usable as recognition marks with this and other accipitrine hawks.

MM Length 10 to 12 inches; slender build; reddish brown on back and tail; light under wings.

O Throat whitish; seldom hovers or soars; white throat patch; head large; speedy; back slaty-blue or brownish; darker in color than the sparrow hawk; rare in California.....(Merlin Hawk) PIGEON HAWK

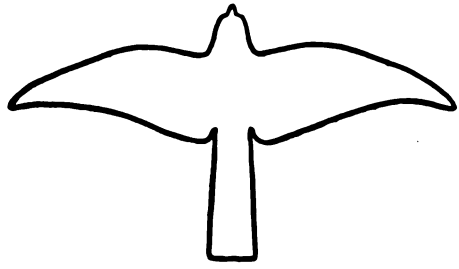

FIG. 49. Outline drawing of a sparrow hawk, made from a specimen, showing the long slender wings and long tail which may be used as recognition marks for all the falcons.

OO Throat not whitish; hovering habit; no white throat patch; wavering flight; back grayish or reddish brown; tail of male reddish brown; top of fence post, telegraph pole or tall tree usual observation station; call, *killy, killy, killy, killy*.....(Killy Hawk) SPARROW HAWK

LL White head; dark back; white breast; extremely long slender wings; black eye stripe with white above the eye; found near water; often to be seen plunging after fish; call, *ki-ik, ki-ik- ki-ik* (Dawson)..(Fish Hawk) OSPREY

A SIZE KEY.

In order to avoid the more technical terms employed in the preceding key, which lays emphasis on the mode of flight, and to make possible identification of a perched bird at fifty yards, the following more simple key is offered. A combination of both the keys will doubtless give the best results.

Size Key to Vultures and Hawks.

Very large hawks—over 30 inches in length—wing spread over four feet.
Body black in color.
Head unfeathered like a turkey; carrion comprises food.
Large, 50 inches in length; white patch under wing_____(Condor) CALIFORNIA VULTURE

Smaller, 30 inches in length; no white patch; wing tips silver grey beneath _____TURKEY VULTURE

Head feathered, white in color; white tail (adult)_____BALD EAGLE

Body brown in color; found in mountainous country_____GOLDEN EAGLE

Medium sized hawks—20 to 25 inches in length.
White on rump.
Distinct white rump patch; long sharp pointed wings; found in and near marshes _____MARSH HAWK

White on each side of base of tail; broad rounded wings; legs feathered giving booted appearance; found in open country_____ FERRUGINOUS ROUGH-LEG

No white on rump.
Distinct black bar or bars on face.
Head white; found near large bodies of water_____OSPREY

Head not white.
Black bluish; usually to be seen near water_____DUCK HAWK

Black brownish; usually found in rough hilly country__PRAIRIE FALCON

No distinct black markings on face.
White stripe over eye; breast finely barred in adult; found in wooded country _____ GOSHAWK

No white stripe over eye.
Black shoulder patches; usually seen near marshes___WHITE-TAILED KITE

No black shoulder patches.
Tail long, barred with black.
Shoulder rusty red; usually seen in willows along streams_____ _____RED-BELLIED HAWK

Shoulder not rusty red; found in wooded and brushy country—the real "Chicken Hawk"_____COOPER HAWK

Tail not long; fan-shaped in flight.
Dark band across breast; found in open country_____SWAINSON HAWK

No dark band across breast; the commonest large hawk_____ _____ RED-TAILED HAWK

Small hawks—10 to 15 inches in length.
White patch on throat_____PIGEON HAWK

No white patch on throat.
Tail reddish brown; dark bars on face, the commonest small hawk_____ _____SPARROW HAWK

Tail not reddish brown; dark bars on face indistinct, if any; found in wooded and brushy country_____SHARP-SHINNED HAWK

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A ROYAL SILVER TROUT CAUGHT IN LAKE TAHOE.

By J. O. SNYDER, Stanford University.

Two skillful anglers, Dr. Ross Harbaugh and Mr. R. L. Handy, who regularly visit Lake Tahoe, report the not altogether infrequent capture of the royal silver trout, a species lately named *Salmo regalis*. That no mistake might be entertained as to their ability to distinguish the species a fine specimen was sent for determination to Stanford University where it was first described. This is the fifth specimen that has come to the hands of a naturalist, and data obtained from it is of great value in assisting to build up a description of the species. Unfortunately, it was eviscerated and nothing may be said of the sex, gillrakers, stomach caeca, etc.

The fish, caught one mile off Bijou, weighed 6½ lbs. and measured about 25 inches. It was greenish blue above, bright silvery on the sides and whitish below. There were a few very indistinct round spots on the head and on the sides below the lateral line. The fins were immaculate. This was a larger example than those originally described* and the head and fins were somewhat shorter.

The following measurements are recorded in hundredths of the length to base of dorsal fin. Length head .20, depth body .215, depth caudal peduncle .095, length snout .062, maxillary .11, diameter eye .03, interorbital width .08, depth head .14, snout to occiput .124, snout to dorsal .455, snout to ventral .54, height dorsal .11, height anal .11, length pectoral .13, length caudal .165. Number dorsal rays 11, anal 11, pectoral 14, scales lateral series 145, above lateral line 20.

There is no reason for confusing this species with any of the introduced forms as the Mackinaw trout for example, but it may be mistaken for silvery examples of the Tahoe trout *Salmo henshawi*, concerning which some remarks may not be out of place here. This is the commonly distributed trout of the greater part of Nevada and of the western slopes of the Sierra Nevada mountains, and it reaches its largest size in the Truckee basin.

This basin includes the Truckee River, Lake Tahoe and tributary streams which form its source, and Pyramid and Winnemucca lakes into which the river flows, and where its waters are finally carried off by evaporation. This basin, none of the water of which reaches the ocean, offers far greater environmental variations than is usual among much larger systems, and the trout seemingly react in a medley of colors, and assume a variety of minor characters such as are not often observed among individuals of a single species.

Many anglers distinguish trout by color and body proportions, and those that fish in the Truckee basin usually recognize several native kinds. First and most commonly known is the Tahoe trout with light olive body and an array of large black spots well scattered over almost the entire surface. Examples in the nuptial dress seen in the spring and early summer have metallic reflections shining through the body color, a broad pinkish stripe on the sides, and a scarlet patch on the cheeks and above the axil of the pectoral fin. The under surface of the lower jaw has two parallel stripes of bright red, and there is a spot of

*Bulletin Bureau Fisheries, Vol. XXXII, 1912.

red on the tongue beneath the tip. One or more bright coin-like spots of orange may be found anywhere on the head. Then there is the silver trout of Lake Tahoe, large in size, silvery in color, with many small narrow spots on the body and fins. It is usually caught in deep water. The royal silver trout not known to some anglers, blue or greenish blue above, silvery on the sides, with very small or not evident spots, might be mistaken for the above. The Truckee trout is the resident fish of the river. It is usually smaller and more brightly colored than the Tahoe trout. Another is the redfish remarkable for the great flame-red patch on the cheek. It is a migrant from Pyramid and Winnemucca lakes, entering the lower Truckee River to spawn. Also there is the tommy, a more modestly colored and smaller fish which enters the lower course of the Truckee to spawn. Finally, the emerald trout of Pyramid Lake which is pale green above, silvery on the sides and with indistinct spots or none. This fish does not enter the river to spawn.

Observation of these fish has convinced the writer that but three species are involved. There are the royal silver trout of Lake Tahoe, *S. regalis* and the emerald trout *S. smaragdus* of Pyramid Lake. These are alike in some respects, and both differ from all the others mentioned in having coarser scales, 124 to 145 series between the head and base of caudal fin. They also have fewer gillrakers and other distinctive characters. As each is confined to its particular lake there is no occasion to distinguish between them, as there is no opportunity to mistake one for the other. The others, the Truckee trout, redfish, tommy, silver and Tahoe trout, all belong to one species, *S. henshawi*. The latter has fine scales, counts of a large number indicating 153 to 163 as usual while a few have as many as 170.

Of these local varieties the redfish and tommy are perhaps the most remarkable, appearing as they do in two great waves of a nuptial migration which passes up the lower Truckee River with the rise of water due to winter rains. Formerly these trout were so abundant as to fairly fill the river at times. The redfish appear first, and as they progress from the lakes their brilliant hues become intensified in the bright desert sun until the whole body shines with iridescent yellow, vermillion and red, the cheek glowing like a coal of fire. The redfish migration wanes rapidly in March, the scouts of the tommies appearing mingled with the last straggling redfish, the more belated of which are lost among the advancing hordes of tommies. The tommy, the name taken from the Piute word tama-agaih, spring trout, is smaller, generally darker in color, and more heavily spotted than the redfish. Silvery tommies and redfish appear late in the season, possibly individuals fresh from the lake.

It will be recalled that the water of Pyramid and Winnemucca lakes is rather alkaline, not fit to drink, yet it supports great numbers of fish. We have here migrations of trout from the lake to the river, like those of steelheads from the ocean. It has often occurred to the writer that observations on the trout of this rather restricted basin might form a sound preparation for a more extended attack on the difficult problems offered by trout of much wider distribution.

THE NEW CALIFORNIA STATE FISHERIES LABORATORY*

By WILL F. THOMPSON.

On June the thirteenth, construction began upon the new California State Fisheries Laboratory at San Pedro, the most important of our fisheries centers. It is to cost in the neighborhood of twenty-five thousand dollars, and will accommodate the present scientific staff of the Department of Commercial Fisheries. The conceptions which gave rise to its building are novel and worthy of remark at this time, for it is not generally known that this project is a distinct and noteworthy departure, a fact which Californians should know and appreciate.

The building will be located near Fish Harbor, San Pedro, within two blocks of the canneries there—with easy access to the vast store

FIG. 50. Elevation of new State Fisheries Laboratory being built at San Pedro.

of fish which is brought into them. The site has been granted to the Commission for a long period by the city of Los Angeles, and its acquisition has been a very fortunate thing. It is at the intersection of Seaside avenue and Tuna street, hence upon the two most important traffic ways in East San Pedro. Seaside avenue will, in the course of a few years, be connected with a boulevard to Los Angeles, through Wilmington and Long Beach. Tuna street, which is but a very short one, terminates upon the water front of Fish Harbor in the center of the canneries. The new building for the San Pedro office of the Commission will be built upon the same plot of ground, of the same type of architecture and will face upon Tuna street.

The laboratory building will be nearly fireproof, of reinforced concrete, with tile partitions and red tile roof. A perspective view of it

*California State Fisheries Laboratory Contribution No. 29.

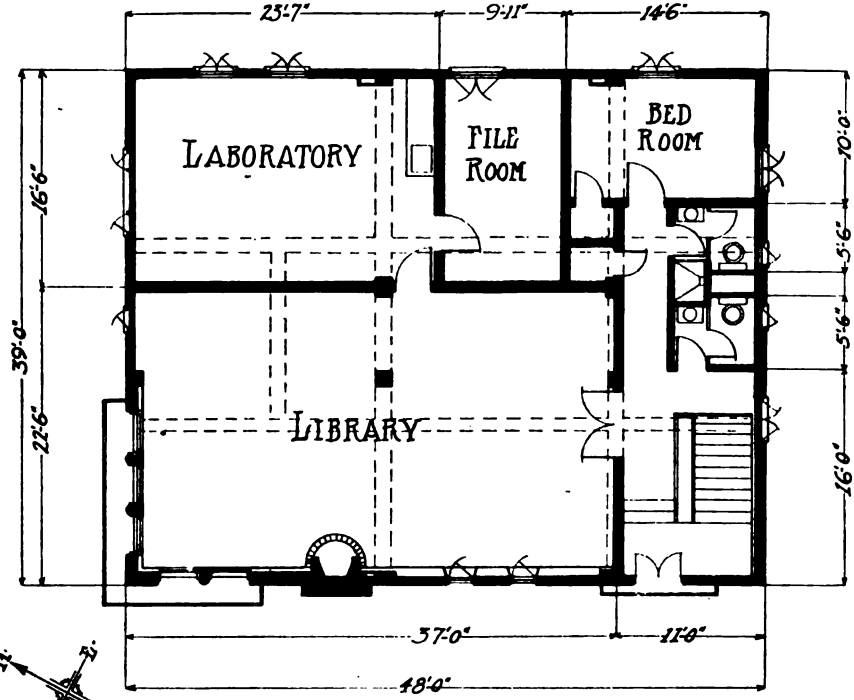
is given in figure 50, and the floor plans are shown in figure 51.* There are two stories. The lower contains two laboratories capable of accommodating several workers, with windows facing nearly north and hence with splendid light for scientific work. It has also a large workroom, floored with cement and with a door through which a truck may enter. There are also a dark room for photographic work and a store room for supplies. The upper floor contains a large room to accomodate the extensive and highly technical library necessary in the work of the laboratory, as well as the files of statistical records which will accumulate. In connection with this room is a laboratory and another smaller room, the latter also destined for statistical files. A bedroom is provided for the accommodation of the student workers who may be employed.

The purpose of this building is to provide quarters for the present scientific work of the commission, the aims of which have been previously stated in CALIFORNIA FISH AND GAME, but which are well deserving of brief recapitulation in this connection since they are in a measure distinct from those of any other biological laboratory, especially of any in America. They are, in the fewest possible words, the observation of the condition of the fisheries with a view to their preservation and freest possible use. That is, true conservation.

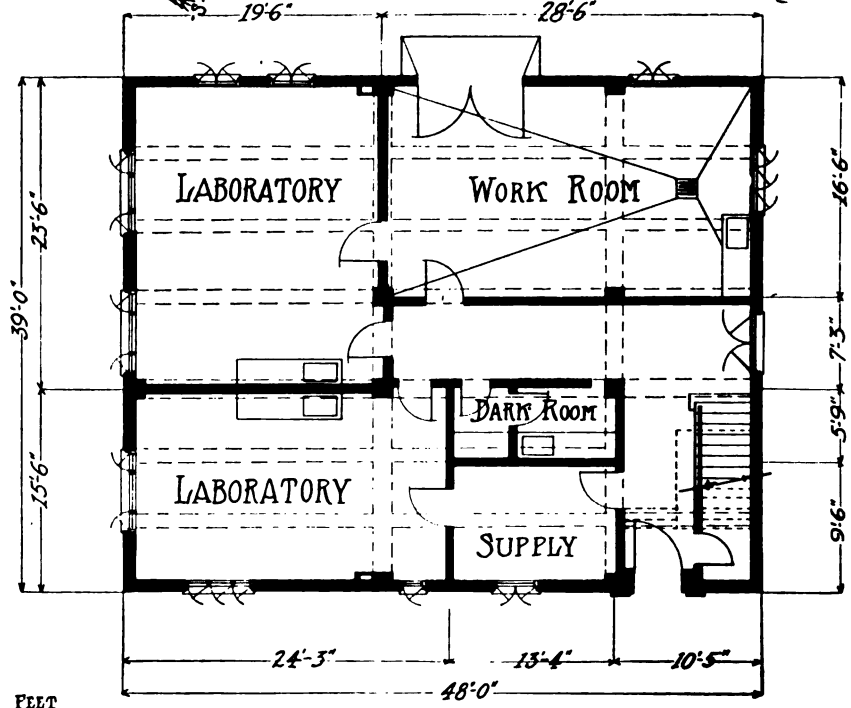
The real abundance of fish in the sea is not obvious to whoever may look. A fishery may languish because of changing natural conditions, despite untouched abundance of fish; or, on the contrary, constantly improved apparatus may yield larger and larger returns in the face of real over-fishing. A fishery is, indeed, highly selective in its action and dependent on many things other than the real abundance of fish. So it happens that "observers" of the highest scientific standing casually contradict each other as to the existence of depletion and the inexhaustibility of the sea. Is it any wonder, then, that the alleged criminal "exploitation," brought before legislative tribunals, pleads—as does the murderer at the bar—that his life be not taken without proof? For opinion, backed by scant evidence, is not proof, and "exploitation" does furnish food for the nation and is respectable, wealthy, and of good reputation generally. Opinions do have a great deal of force where, as in the case of conservation of birds and mammals, mere observation in the field is convincing to any fair-minded person, but in the case of marine fisheries this is not true.

So, in place of opinion, the real conservationists—and among these are many of the commercially interested men—must endeavor to furnish what is tantamount to legal proof. Such men as have composed the Scottish Fishery Board—men who have patiently and carefully examined into the condition of various fisheries—have proved the existence of depletion in several of these fisheries, and have demonstrated the character of data necessary, and we have profited by their experience. These data are statistics, so detailed, so extensive, and so accurately gathered that changes in gear, changes in fishing ground, and many other things may be discounted. Such data must also be examined and tested by the biologist with his criteria of over-fishing. To give such

*By courtesy of the State Engineering Department, the floor plans modified by Mr. Higgins for purposes of reproduction.



SECOND FLOOR PLAN



FIRST FLOOR PLAN

proof as these data provide, is the purpose of the new laboratory. It is for the digestion and biological analysis of statistics.

Until such is done neither can exploitation proceed freely, nor may we be sure that over-fishing will not go so far as to be irremediable. There is, after all, no method for knowing how much strain a fishery will endure save by trying it, and this implies the duty of careful observation. That duty rests with the government in legal control of the fisheries and their machinery of exploitation.

The Fish and Game Commission has, in California, a system of statistics entirely suitable for such analysis. That now in use is without parallel in any country or state, to the best of our knowledge, and forms a wide and firm basis for true conservation. It is not based on estimates, volunteered information, nor inquiry, but is an actual record of the commercial transactions which take place between fisherman and dealer. This record is from carbon copies of the fisherman's receipt upon which he receives his money, and is far more probable to be correct, naturally, than any other record obtainable. It has actually provided many of the fresh-fish dealers with a record of their transactions for the first time. With all its faults—which those concerned with its administration are prone to magnify rather than ignore—so much light has been thrown upon the returns formerly obtained by inquiry and circulated questionnaire, that we regard them as of small value in comparison with what we now get.

But in addition to the high degree of accuracy, it is now possible to follow the catches of single boats from year to year, and thus to accurately compare the abundance of fish from day to day and from year to year. And it is the interpretation of the statistics from the standpoint of changes in abundance—including depletion—to which the new laboratory will be mainly devoted. The distinction between the effects of over-fishing and those of hydrographic or economic changes, and the explanation of the latter, imply the careful analysis of statistics from a mathematical and biological standpoint. It will be the function of the new laboratory to contribute toward that end, and toward the formulation of whatever knowledge exists. Such a function, it should be noticed, is based primarily upon the legal control of the state over its fisheries, and upon its power to enforce the gathering of statistics—thus assuring, we believe, the permanency of the work.

Finally, attention might be called to the fact that the vast quantity of material handled by the commercial fisheries provides an unequalled opportunity for the solution of many of the major problems of biology. We trust that the laboratory will make its contributions to those as well as to the more immediate ends.

To the proper furtherance of the aims we have outlined above, the statistical files from the state will be placed in the new laboratory, where they will be—in accordance with the law—safe from damage and accessible to investigators.

It has been realized, however, that to secure proper support for the work in hand, an exhibit open to the public will ultimately be necessary. The results obtained, the facts known about our fisheries and those of other countries, must be presented graphically and attractively. So it is planned at some time in the future to add a large, well-lit exhibit room on the southern face of the new building, between the laboratory and the new office quarters.

AN IMPORTANT DECISION ON THE FISHWAY LAW.

The Anderson Cottonwood Irrigation District is a political subdivision created under the provisions of the Irrigation Act.

The district constructed a dam across the Sacramento River above the city of Redding, Shasta County, which prevented the passing of fish up the Sacramento River. Under the provisions of section 637 of the Penal Code the district was served with a notice to construct a good and sufficient fishway over said dam.

The district refused to comply with the order and on December 20, 1920, injunction proceedings were begun against the district by Hon. Jesse W. Carter, district attorney of the county of Shasta and an application made by him for a temporary injunction restraining said district from operating said dam.

The hearing on the temporary injunction was set for January 7, 1921, before the Hon. Eugene P. McDaniel, judge of the superior court. Defendant Anderson Cottonwood Irrigation District filed a demurrer and on January 7, the matter was argued and submitted and on May 19, 1921, Judge McDaniel rendered his decision, a copy of which follows:

In the Superior Court of the State of California, in and for the County of Shasta

THE PEOPLE OF THE STATE OF CALIFORNIA, *Plaintiff*, vs. ANDERSON-COTTONWOOD IRRIGATION DISTRICT, A BODY POLITIC AND CORPORATE AND W. F. SMITH, CHARLES HAMPTON, CHARLES SPANN, W. A. BROWN AND EARNEST SCHULER, AS DIRECTORS OF SAID ANDERSON-COTTONWOOD IRRIGATION DISTRICT, *Defendants.*

The complaint in the above entitled proceeding, after the statement of necessary formal matters, alleges that the Sacramento River is frequented by a great number of salmon and is regularly stocked with salmon by the Fish and Game Commission of this state; that the upper reaches of said river above Redding are the natural spawning grounds of said salmon; that the defendants have constructed, operated and maintained across the entire width of the river at the city of Redding, a dam for the purpose of diverting the waters of the river into the main canal or ditch of the defendants; that said dam constitutes an obstruction in the river which prevents the free passage of salmon over, through, by or around said dam, and that by reason thereof, said salmon are prevented from reaching their natural spawning grounds and thus prevented from propagating, reproducing and replenishing the river with salmon, which are alleged to constitute one of the valuable natural food supplies of the people, of great monetary value; and that unless the obstruction is removed, said salmon, by reason of their inability to reach the spawning beds annually and reproduce themselves, will be shortly and ultimately exterminated, to the great and irreparable loss, damage and injury to the people of California; that the maintenance of said dam by defendants is in violation of the rights of the people and constitute a public nuisance; that defendants threaten to maintain, and unless restrained by the court, will maintain the dam to the plaintiff's irreparable injury.

Following, the complaint then prays:

1. For a permanent injunction against defendants to enjoin and restrain the maintenance of said dam across the river and from obstructing the river so as to prevent the free passage of salmon;

2. That defendants, upon an order to show cause, be enjoined *pendente lite.*

Defendants have demurred on general grounds to said complaint and have made return to the order to show cause, and support said return by a number of affidavits. Upon the hearing testimony was received from witnesses for both parties upon a stipulation that the testimony should be transcribed and considered as affidavits upon the consideration of the said application for an injunction *pendente lite.*

The defense contends: 1. That an adequate fishway has been provided in its dam;

2. That the irrigation district is a political subdivision of the state, exercising a function of the state government;

3. That the injunction, if granted, would prevent the execution of a public statute by officers of the law for the public benefit;

That the injunction cannot be granted to prevent the execution of a public statute by officers of the law for the public benefit; and that nothing which is done or maintained under the express authority of the statute can be deemed a nuisance;

4. That in this proceeding, under the facts shown by the affidavits and testimony on the part of the defendants, estoppel against the state has been established;

That the dam in question is under the authority of the Department of Engineering, and not the Fish and Game Commission.

5. That by the enactment of the California Irrigation District Act, the state has not only waived its property rights in the stream by implication, but has, by the provisions of section 56 of the act, expressly granted such rights to the district.

Some of the foregoing matters were presented in support of the defendants' demurrer to the complaint, and nearly all of them were urged in support of defendants' opposition to the issuance of a temporary restraining order.

It is not necessary for this court in a long opinion to review the many authorities cited in the exhaustive and able briefs of respective counsel. Only those authorities will be cited which are necessary to notice as support for the court's conclusion upon the issues.

The demurrer will first be disposed of. In my opinion the facts stated in the complaint are sufficient to constitute a cause of action, and when conceded to be true, as they must be on demurrer, show such an obstruction of the free use of property as to interfere with the comfortable enjoyment of life and property, not only by an entire community and neighborhood, and a considerable number of persons, but by all the people of the State of California.

People vs. *Truckee Lumber Company,* 116 Cal., 397;
Yolo Water and Power Company, a corporation, vs *Superior Court,* Vol. 30, C. A. D., 3.

The last above cited case in my opinion disposes of several of the defenses of the defendants herein, in as far as those defenses bear upon the demurrer. It holds that the superior court has jurisdiction to hear and determine a suit brought in the name of the People of the State of California, against a public utility to enjoin it from committing a public nuisance.

This case is also reported in 185 Pac. 195, and seems to be the latest expression of our courts as to the right to maintain a suit against a public utility for the abatement of a public nuisance by an injunction. It is my conclusion, therefore, that the demurrer should be, and it hereby is overruled.

The testimony produced by the respective parties in affidavit form and that orally received by the court from the witness stand was irreconcilably conflicting. That on the part of the defendant controverted or at least attempted to controvert every material averment of the complaint as to the creation of the public nuisance in question.

In view of the conclusion reached as to the issuance of a temporary restraining order, it will be unnecessary at this time for the court to decide some of the contentions, for instance the matter of estoppel *in pais* urged by the defendant. However, the opinion may be expressed that there was not sufficient evidence on the part of the defense to establish any estoppel as against the plaintiff.

The general laws of the state, particularly those of the Penal Code, furnish ample authority for providing adequate fishways over dams and artificial obstructions. The California Irrigation District Act furnishes ample authority for the building of obstructions and dams in the streams of California for the purposes of irrigation; but there is no necessary conflict, implied or otherwise, in the statutes relating to these matters, nor any adequate reason for any clash of authority between different state agencies in enforcing all the laws.

It was never the intention of the Legislature, in enacting the irrigation law, to permit irrigation districts to destroy the fishing interests of the state, nor was it its intention to permit the penal laws to operate in such a way as to prohibit the construction of necessary works needed for the development of vast irrigation projects. These laws must all be given a reasonable interpretation and so carried out and enforced as to avoid unnecessary conflict, and so that all of the varied interests of the state may be conserved. The plaintiff herein seeks not the destruction of the dam across the Sacramento River, but only desires to prevent its maintenance in such a manner as to bring about the destruction of the fish in the stream.

In my opinion, there is little merit in the argument that this proceeding is an attempt to interfere with the operation of any public statute.

The testimony for both parties on the hearing shows that the dam in question is at most not to exceed fifteen feet in height and it therefore undoubtedly is true that it is reasonably possible to construct an adequate fishway over, by or around the said dam, if the opening now existing in the middle of the dam, as a matter of fact, be an inadequate fishway or no fishway at all, which is the big question in the case.

Upon that question, as noticed before, there is so far such conflict as to require in its determination a decision upon the merits of the whole case. While it would seem that perhaps enough testimony was received by the court to enable it to resolve the conflict, I feel sure that there would be grave danger of error and injustice by its determination at this time. Witnesses for the plaintiff of reputable character in all respects testified to facts indicating that it is a practical impossibility for spawn-laden fish to pass through the twelve foot opening in defendants' dam during the running season to the spawning grounds. In opposition, equally reputable witnesses on behalf of defendants swear positively that such salmon readily pass up the river

through the said opening. One witness declares he observed as many as ten salmon pass up and over the dam through the opening in five minutes.

The court is astonished there should be such a conflict on a question capable of actual demonstration. It should be easily determined by ocular investigation during the fish running season. When the matter is fully at issue, the hearing may be brought on before the court during the spring or fall run of salmon; if respective counsel and the court will arrange to have the suit heard at such a time, then in addition to hearing witnesses testify, the court, if it saw fit, could actually go to the dam and there by observation and examination, learn the real facts.

While now satisfied that it is probable that there is a serious obstruction to the free run of salmon and grave danger of depletion in the number of salmon reaching the spawning grounds, with consequent injury to a renewal of the supply, the court is not now satisfied that there is danger of irreparable injury; at any rate, irreparable injury greater in estimation than might result to the defendants and to the people at this time, if the defendants should be compelled, by a mandatory injunction, to make a larger opening in the dam, as the irrigation season is almost at hand and defendants' supply of water might be cut off by the issuance of such injunction *pendente lite*.

Upon the authority of the cases cited by defendants' counsel, viz., *Gagliardo* vs. *Crippen*, 22 Cal. 362, and *Schwartz* vs. *Arata* et al., Vol. 31, C. A. D. 265, 188 Pac. 313, it clearly is a matter of discretion with the court whether to issue the injunction or not, and in view of the foregoing considerations, in my opinion, no injunction should be issued until the case is heard upon its merits.

To recapitulate: 1. It hereby is ordered that plaintiffs' motion for a temporary restraining order or injunction *pendente lite* be and it hereby is denied.

2. It hereby is ordered that defendants' demurrer to plaintiff's complaint be and it hereby is overruled, with leave to defendants to file their answer within ten days.

Dated: May 19, 1921.

(Signed) EUGENE P. McDANIEL.
Judge Presiding.

This is a most important decision upon the law of fishways for there is no doubt that when a trial is had on the merits of the case it can be shown that the dam in question is such an obstruction to the free passage of salmon that unless a good and sufficient fishway is constructed it will completely exterminate the run of salmon on the Sacramento River, its tributaries, McCloud and Pitt, and other streams.

CALIFORNIA FISH AND GAME

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All material for publication should be sent to H. C. Bryant, Museum of Vertebrate Zoology, Berkeley, Cal.

JULY, 1921.

A HAWK NUMBER.

This number contains an article designed to interest our readers in the conservation of hawks. Beneficial hawks, because of deeds committed by a few relatives, have received much persecution at the hands of farmer and sportsman. Being large conspicuous birds and with a slow rate of increase they have suffered more than others; some species have been practically exterminated. The Condor, or California Vulture, is now one of the rarest birds in the state and the White-tailed Kite is approaching extinction. Neither can be considered injurious species. In addition to a discussion of the economic value of the various species of hawks based on California data, there is added a field key which it is hoped will be found useful by those desiring to distinguish the beneficial from the injurious hawks. An attempt has been made to use characters helpful in field identification rather than those useful with a bird in the hand.

SOME OF THE IMPORTANT CHANGES IN THE LAWS AFFECTING GAME.

A number of important changes were made in the seasons for taking game, at the 1921 session of the state legislature.

The deer season in the Sierra districts and also in Humboldt, Del Norte and Siskiyou counties will not open until September 1 and will close October 15. In southern California the season will not open until September 16 and will close October 15. In the coast districts the season will be the same as last year, opening August 1 and closing September 14.

Ducks, geese, brant, jacksnipe and mudhens may be killed from October 1 to January 15.

The most radical change was the creation of practically a blanket season on all species of quail. Heretofore, mountain quail could be taken in the Sierra districts September 1; under the new law the season will not open (except in Del Norte, Humboldt and Siskiyou) until November 1 and will close January 15. In the counties mentioned quail may be taken between October 15 and December 15. The same season for taking quail will apply to cottontail and brush rabbits, November 1 to January 15.

Sage hen may now be taken from August 1 until September 15. This will give an opportunity to take young birds before the flesh has become strong from sage. In district 4½ sage hen cannot be taken at any time of the year.

The change in the trout law delaying the opening of the season one month in the principal districts will give much better fishing within the next few years. Trout have not finished spawning by the first of April and if the supply of fish for the greatly increased number of anglers is to be kept up, breeding fish must be given every opportunity to spawn. Under the new law the season will be open from May 1 to October 31 in districts 1, 1½, 2, 3, 4 and 4½. A new district was made in the western part of Mendocino County consisting of that portion of the county draining direct into the Pacific Ocean. In this district, known as 2½, the trout season will be open from July 1 until Febraury 14. The season in the Tahoe and other smaller districts will be the same as last year.

Another important provision in the trout law is the reduction of the limit to 25 fish per day. This will be a great help in keeping California streams filled with trout. Added protection is given trout and other game fish by a new section numbered (632 a) and by an amendment to the section referring to night fishing and hunting. Section 632a prohibits the placing of any obstruction in any stream that will impede in any way fish from making their way up and down stream.

The other section provides that no game fish may be taken between one hour after sunset and one hour before sunrise.

The section prohibiting hunting in game refuges was amended so as to prevent the possession of game or fire arms in any refuge except under permit from the Fish and Game Commission.

SUMMER RESORT WORK TO BE CONTINUED.

Several years ago the Fish and Game Commission began carrying their educational campaign into the summer resorts where it was found that people were particularly susceptible to information concerning fish and game and wild life conservation. It was found also that a large number of people could easily be reached in a short length of time. Under urge from the National Park Service an intensive educational campaign was undertaken in Yosemite National Park, under the title "Nature Guide Service." Thousands were taken on trips afield gaining first hand information of wild life and over twenty-six thousand persons attended camp-fire talks and illustrated lectures given by the nature guides.

This work is to be continued in Yosemite during the summer of 1921, the Fish and Game Commission sending their educational director, Dr. H. C. Bryant, to take charge of the work. Dr. L. H. Miller, of the Southern Branch of the University of California, will share in the work and other assistants have been provided. Nature study libraries and exhibits showing the work of the Commission form a part of the program. "To read nature as one reads a book" is the motto followed. Certainly, work of this kind is of great service in building a public sentiment favorable to wild life conservation.

ARE BAG LIMITS TOO LARGE?

Consideration of present day game laws and the need for more restricted bags leads one to question the advisability of continuing to allow each hunter to have a separate bag limit on the various species of game. Why should a man be allowed twenty-five ducks, eight geese and twenty-five snipe in a single day should he be able to secure them? Or why should the law allow the upland hunter fifteen quail and fifteen doves in one day? Certainly, such bags would be far more than a man could utilize himself or advantageously give away.

The day is not far distant when bag limit laws will be effective regardless of species. Fortunately, there is a tendency among hunters to limit their kill to the number of birds they can utilize, and consequently, such a law would only curtail the game hog.

DUCK HUNTING FROM AN AIRPLANE

There has been considerable discussion and consequent investigation concerning the protection of the rice fields from the depredations of ducks. In 1919, it was decided that the most effective methods of control were to be obtained by herding and bombing, and the government solution of the problem appeared satisfactory to the growers.

Since then a good deal of publicity has been given the method of protecting rice crops by airplane duck patrol. The Standard Oil Bulletin, November, 1920, states that: "last year an aeroplane patrol was established as an experiment. It worked so well that this season it was repeated, and now five planes are kept busy, making both day and night flights to frighten off the wild ducks."

The American Game Protective Association makes the following criticism:

"We have been told that permits were granted to the rice growers of California to use aeroplanes to frighten the ducks from their growing crops. This appeared to us to be a very good idea, as efforts to frighten birds away from growing crops by gunfire has never accomplished the results desired, and is nearly always used by unscrupulous gunners as an excuse to shoot out of season. However, if aeroplanes under permits of this kind are actually killing birds, such permits should be immediately revoked."

Last fall a motion picture was shown over the country of one of these hunts, and at the same time, pictures appeared in the Sunday news supplements which showed that many birds were slaughtered by being hit with the propeller and other parts of the machine. The projection of the motion pictures was discontinued when it was learned that this picture was causing many protests, and that investigations

were being made to ascertain where the pictures were taken. The supposition seems to be that it was photographed in California, and that the airplane was operated by an army lieutenant from Cressy Field. If this proves to be the case, certainly some immediate provision should be made to protect the migrating waterfowl and to prevent a glaring violation of the Migratory Bird Treaty Act. The state law prohibits the shooting of game birds or mammals from an airplane, but does not definitely provide against ruthless slaughter by propeller and guy wires.

FIG. 52. Airplane routing ducks from the rice fields. Photograph by L. V. Halbrook, special Standard Oil agent at Willows, California. Courtesy of the Standard Oil Company of California.

SALMON DEPLETION IN BRITISH COLUMBIA.

During the war there was a noticeable dependence upon the results of scientific research. It is becoming more and more evident that more dependence can be placed upon conclusions of men who have scientifically investigated a problem than upon the guesses of the untrained worker. We have seen no better example of this change in attitude than in the recent reports regarding the prospective take of salmon in British Columbia during the coming season. Even the "British Columbia Financial Times," a journal of finance and commerce, has published in full the report of Dr. C. H. Gilbert, of Stanford University, who points a dark future of the salmon run in the Fraser River. He offers the ominous prediction that "big years" are wholly a thing of the past. The same article accompanied by an editorial appears in the "Canadian Fisherman," (March, 1921). On the basis of the findings of this scientist also, the American Can Company is planning to furnish only one-third of the number of cans usually supplied the canneries of this section.

Thus it can be seen that the predictions of a scientist bear more weight than those of the average fisherman who would predict, on the basis of past cycles, another splendid season for the year 1921.

In Dr. Gilbert's article, "The prospects of Fraser River sock-eye run in 1921," he states that two entirely independent lines of evidence had pointed to a greatly decreased run of salmon in 1917. One of these was the blockade of the Yale Canyon in 1913, which was just in time to

intercept the spawning run of that year —due to be a "big year," for prior to 1917, a big year occurred without fail in every fourth season. In 1917, a pack of 560,000 cases was produced, little more than one-fifth the pack of the big year of the previous cycle.

It is known to all packers and fishermen that the year before the large run was always made conspicuous by the occurrence of large numbers of greatly undersized individuals—male fish—which evidently constituted a class apart from the main body of the run, and which in the small years of each cycle were rarely encountered. The packers put up these fish separately because they contained less oil and were paler in color, as an inferior grade. They were thus in a position to compare their abundance in the years of their occurrence with that of four or eight years previously. From observations made, it came to be currently believed that whenever the number of small fish was relatively large then the big year which followed would be correspondingly increased in comparison with other big years. Then it became further known that the "usual run of sock-eyes to the Fraser were maturing the fourth year of their age, while these undersized males—or grilse, as we call them —were maturing in their third year; and they would therefore make their appearance in the run one year earlier than would the four-year fish which resulted from the same spawning. If, then, the spawning of the last big year had been an unusually successful one, this might be expected to result in an exceptionally large run of grilse three years thereafter, and an equally exceptional run of the four-year fish which would constitute the big run of the following year. The number of three-year grilse in the year before the big year might well, therefore, give a clue to the probable size of the big year itself."

For this year, the same two lines of evidence are available. The data derived from the numbers of grilse, which made their appearance, and the success of the spawning fish of the three and four-year cycles, both point to a definitely worse condition for 1921.

Careful study and investigation which began in 1911 has satisfactorily determined this conclusion, and Hon. Wm. Sloan, Commissioner of Fisheries for the Province of British Columbia, is quoted as having said, "Dr. Gilbert's paper must, I think, impress the fishing interests of the state of Washington of the necessity of prompt action, and that the methods that must be adopted to reestablish the runs to the Fraser, which in former big years were so profitable to them and our own interests, will be equally successful in restoring the runs of the lean years."

CONSERVATION AND THE SCIENTIFIC COLLECTOR.

For several years past there has been a tendency in many states to restrict the scientific collector of bird specimens and eggs. In some states, the privilege of scientific collecting has been entirely prohibited. Since practically all useful information regarding wild birds and animals is a result of the acquisition of specimens, the necessity for work of this kind is evident. The curtailing of scientific collecting must result in decreased scientific information. Furthermore, there is the danger of decreasing the number of ornithologists by cutting off the opportunity for the right sort of study. Our best ornithologists owe their early interest and their development largely to the unrestricted chance for securing specimens.

We have grave doubts as to the wisdom of tightening up on those who are solely interested in birds from the scientific point of view. We cannot understand from whence comes the pressure which forces government officials or state officials to further restrict the collector. Certainly, such restriction cannot be considered an important conservation measure, as compared with other measures. Compare the effect on the species wrought by the sportsman and that by the work of the scientific collector. The sportsman is allowed twenty-five ducks in a single day and fifty per week. There are no collectors in California, even including public museums, who add twenty-five specimens of ducks to their collections in a whole year. Note also that the sportsman concentrates his attention on a few species of game birds, taking a large toll, whereas, the scientific collector obtains protected song birds largely, on which there is no concentrated hunting and

where the toll is respectively very small on any one species. There are about one hundred and fifty scientific collectors in California as contrasted with more than one hundred and eighty thousand hunters. Hardly one of these collectors hunts for sport. Specimens of eggs taken do not represent, as a rule, a lessening in the annual increase of a species, for a second clutch of eggs is nearly always laid. Conservation is not hindered but advanced.

The test of legitimate collecting should be placed upon the spirit of the collector, and so long as he demonstrates that his interest is in a scientific study of wild birds and animals and that he can contribute to science, he should be encouraged rather than discouraged.

POWER PROJECT HEARING.

An important hearing on the project for the building of a large dam on the Klamath River was held at Yreka on May 12. The Federal Power Commission delegated F. H. Fowler, district engineer of the United States Forest Service, as chairman. The protestants represented were the Shasta Valley Irrigation District, Yreka Chamber of Commerce, and the Fish and Game Commission.

The certain destruction of the salmon run in the Klamath River, as a result of the proposed power project, has led the commission to oppose the undertaking. Dr. J. O. Snyder, of Stanford University, acting as a fishery expert for the commission, pointed out that two species of trout, in addition to the salmon, would be ultimately destroyed, if prevented from reaching their breeding grounds. He also pointed out that the salmon when they reach the lower part of the river are unripe and that spawning operations under such conditions would be practically impossible.

Residents along the Klamath River pointed out the value of the river as a spawning stream. The contemplated new road from the coast to Yreka will open the stream to recreationists and the destruction of the game fish in the river would have a bearing on the whole country.

TRAPPING WATERFOWL ALLOWED IN ENGLAND.

A recent conversation with a well-known sportsman naturalist who has just returned from England brought out the astonishing information that the trapping of waterfowl attracted to a locality by decoys is still allowed in Great Britain. This method of securing game birds has been frowned upon for many years in America and the average sportsman would point out the great danger to waterfowl as the result of such methods. Yet, apparently, waterfowl shooting continues to be good in Great Britain. What the compensating factors are, we do not know. We wonder whether there is as concentrated hunting and as many hunters in England as there are in America.

GOOD BLACK BASS FISHING IN LAKE COUNTY.

Few Californians realize the splendid black bass fishing to be had in Lake County. With favorable weather conditions, the finest sport can be obtained. The season, which usually begins on April 1, has been rather late this year, nevertheless, a catch of twenty-two was made during April. Sportsmen of Lake County are offering a fifty dollar prize for the largest black bass taken during the season. The two fish standing highest thus far in the contest weigh six pounds four ounces and seven pounds twelve and three-quarters ounces respectively. The fish from Clear Lake and Blue Lakes, coming from cold water, are much more palatable than those taken from the warm muddy water of our larger streams. The lakes of Lake County deserve to be the mecca for the black bass fishermen of middle and northern California.

LAKE COUNTY SPORTSMEN ORGANIZE.

Lake County sportsmen always noted for their interest in fish and game, have lately organized the Lake County Fish and Game Protective Club. They have already lined up one hundred and eighty men to attain the following objects:

"The protection and conservation of fish and game abounding in Lake County in particular and the State of California in general; to promote and encourage clean and law-abiding sport with rod and gun, target and trap shooting, and other forms of sport which may be indulged in under the supervision of this Club and at all times, to insistently discourage any and all violations of the fish and game laws of this State, and to lend assistance wherever and whenever possible to the proper authorities in prosecuting any and all such violators."

The dues of the organization are only one dollar a year. Already traps have been installed at Lakeport, and money has been appropriated for a permanent acquarium in San Francisco to boost the black bass fishing in Lake County. Deputy J. D. Dondero has been active in forming this new club.

JUDGE CLAYTON AND THE MIGRATORY BIRD LAW.

If all Federal judges delivered charges of a similar character to that of United States District Judge Henry D. Clayton, it is believed that the people generally would be educated up to the point where they would recognize the need for such laws as the Federal Migratory Bird Treaty Act and would demand a strict observance and enforcement of it. In delivering his charge to the grand jury at the spring session of the United States court at Opelika, Alabama, on April 4, this judge devoted a portion of his address to the Federal Migratory Bird Treaty Act.

Judge Clayton spoke as follows:

"Gentlemen of the grand jury, I call your attention to our National Migratory Bird Law. I do this for the purpose of asking you to examine into any infractions of this law, and also for the purpose of directing public attention as far as I can to this important subject, to the end that uninformed sportsmen may not violate the law and to warn those who are not sportsmen that they must not violate the law."

He emphasized also the need for those who know of the law and who realize its importance to talk on the subject at every convenient opportunity, especially, to the young people, in order that they might be better informed.

To the sportsmen he said:

"Every man who loves the sport of shooting should send a request to the United States Department of Agriculture and ask for Bulletin 1138, which contains the game laws, state and Federal. It will cost only the postage on his letter or card."

In conclusion Judge Clayton laid particular stress on the fact that Congress and the courts aimed to uphold this law. His closing statement was as follows: "Let me emphasize the fact that it is the intention of Congress and the courts to have this law enforced."

RESOLUTION ON THE CONSERVATION OF FISHERIES.

The following resolution has been submitted to a conservation committee of the San Diego Society of Natural History:

WHEREAS, It has been repeatedly shown and is well-known that over-fishing has depleted or destroyed the fisheries of anodromons and of ground fishes in easily accessible coastal waters everywhere to the serious injury of peoples dependent upon them for food;

WHEREAS, There is evidence that the rapidly improving methods of fishing are threatening pelagic fisheries with similar depletion or destruction;

WHEREAS, These dangers to both types of fisheries are seriously increased by the use of enormous nets and other gear which injure or capture many fishes not salable or which injure and fail to capture many of those salable which escape to die because of their injuries;

WHEREAS, Due to use of such gear there is further danger to such fisheries by disturbance and breaking up of spawning beds for either themselves or fishes upon which they prey;

WHEREAS, There is frequent wilful violation of protective laws on the part of commercial fishermen, especially certain aliens who also wantonly waste and destroy great quantities of sea foods which they can not successfully market; and

WHEREAS, It cannot be expected that commercial fisheries under a system of open competition can possibly protect these marine resources from dangerous exploitation; be it

Resolved, That this organization urge upon our people the necessity of providing adequate limitation as to numbers and equipment of commercial fishermen, together with complete prohibition of net and other gear which is highly destructive or injuriously disturbing to marine conditions of life;

That we deplore the activities of destructive and irresponsible aliens for which we urge completely repressive measures;

That we hereby approve and sustain those efforts of our public officials which tend to preserve these valuable resources, and

That we urge and encourage these officials to still greater effort as opportunity may be found in that direction.

CHINOOK SALMON IN LAKE ONTARIO

The United States Bureau of Fisheries, during the fiscal year 1919, planted 434,500 Chinook fry and 149,500 Chinook fingerlings at different points in Lake Ontario, and these fish, which have now reached a length of about ten inches, have been found at the mouth of the Niagara River.

Mr. H. Otto Wagner of Youngtown, New York, who operates a fishery at the mouth of the river, states that sixteen of this species have been caught which were all about the same size. An expert in the Bureau of Fisheries identified two fish sent by Mr. Wagner to the commission on October 27, 1920, as Chinook salmon nearing the end of the second year of growth. — *The Conservationist*, March, 1921.

THE FISH AND GAME COMMISSION PATROL SERVICE.

In considering the patrolling duties of the Fish and Game Commission, we are convinced that those entrusted with this responsibility are leading a very active life.

The patrolling service consists of the water patrol and the land patrol forces.

Patrol Boats.

In 1910, the patrol boat "Quinnat," which is a cruiser, or raised deck type of boat, was built for the commission, and today the commission has six patrol boats for the enforcement of the fish and game laws of the state.

San Francisco Bay and the near outside waters are covered by the boats "Quinnat" and "Steelhead," the river fishing districts by the boats "Rainbow," "Barracuda" and "Shad." The first two are commercial fisheries patrol boats, while the other three come under the heading of general patrol, as they have considerable game as well as fisheries patrol work to do.

The "Albacore," built in 1918, is used for the patrol of southern California waters. It is sixty feet in length with a cabin and accommodations for six persons. The boat is used for patrolling and investigation work from Santa Barbara to San Diego. The average mileage for this boat for the twelve months during 1920 was 541.6 miles per month—this figure includes all time lost in lay ups, stopping for repairs, etc. And although the figures for 1918-1919 are not at hand the mileage was probably more.

Land Patrol.

Patrol by land and water are closely linked together, for in connection with the Commercial Fisheries' patrol service there are three men in the employ of the commission who work about the piers and the fishing docks. Such patrolmen are stationed at San Pedro, San Diego and San Francisco. The man at San Francisco gives this branch of the work all of his time.

Aside from the water front patrol there are the game wardens and the deputies who also work out from each district office. A number of these men have automobiles, and in the mountainous and wild trail country the distances are covered on horseback. The average number of miles covered per month by automobile by the deputies of the commission has been estimated to be 935. During the trout planting seasons, their travel is necessarily heavier than during the other seasons of the year, for the two Fish and Game Commission distribution cars must be met by the men with their trucks to handle the shipments of fish, and the distribution ars alone covered during the past two seaons 65,000 miles. Without in this instance mphasizing the other phases of the work of these men it is interesting to see how perpetually the men of the patrol force must be "on the job" in the discharge of their duties.

MUNICIPAL CAMPS INCREASE IN NATIONAL FOREST PARKS.

Free permits for eight municipal recreation camps in the national forests of California have been issued by the Forest Service of the United States Department of Agriculture. This state is taking the lead in establishing these camps, where the residents of the cities which maintain the camp may obtain a summer outing at cost.

Last year four such camps were operated in the California National Forests —two by the city of Los Angeles and one each by Sacramento and Oakland. These four represent an investment of $70,000, and nearly 5000 guests were accommodated.

This year Los Angeles will have a third camp in operation, and San Diego and Fresno and Riverside counties expect to open camps also. In addition to its camps, the Los Angeles Playground Department organizes and supervises two-week hiking outings in the Angeles Forest. Three of the eight camps are in the

Angeles, two in the Cleveland, and one each in the Sierra, Stanislaus and Eldorado National Forests. The camps are from 25 to 150 miles from the municipalities that maintain them.

Only residents or taxpayers of the municipalities that operate the camps are eligible as guests, and, because of the low cost of the outing, each camper is required to render on an average one hours' daily service as outlined by the director in charge, and must also furnish his own bedding. Guests are well housed, fed, and entertained. The following rates for a two-week outing, including transportation, were in effect last year:

National forest.	City.	Name of camp.	Mls. to emp.	Cost.
Angeles	Los Angeles	Peeley	75	$12.75
Do	do	Radford	96	14.25
Stanislaus	Oakland	Oakland	150	18.00
Eldorado	Sacramento	Sayles Flat	90	25.00

These rates were all for adults, and the rates for children under 10 were from 50 to 60 per cent of the above. The lower rates at the Los Angeles camps are probably accounted for by the fact that these camps have been in operation for several years, while 1920 was the first season for Sacramento and Oakland. The Los Angeles camps accommodated over 3500 of the 5000 guests at the municipal camps in the national forests of the state. The business men of Sacramento are so well pleased with their municipal camp that they are raising a fund of $10,000 to be donated to the city to build permanent cabins at the camp for sleeping quarters, such as are already installed at the Los Angeles camp.—*United States Department Agriculture* Weekly News Letter.

ESTABLISH QUARANTINE ON FOXES IMPORTED FOR BREEDING.

To protect owners of fox farms, the Secretary of Agriculture has ruled that all foxes offered for importation into the United States from any part of the world, except those imported for zoological gardens or similar institutions, shall be subject to inspection by an inspector of the Bureau of Animal Industry. The foxes must also be quarantined under the supervision of the inspector of the bureau until it can be determined by inspection or examination whether they are affected with a contagious disease. If such disease is found, the animals must be returned to the country of origin or be destroyed. This regulation goes into effect June 1, 1921.

The new regulation states that permits must be procured for all foxes offered for importation into the United States as provided by Regulation 11, for the importation of cattle, sheep, goats and swine, and all foxes imported for breeding purposes must be entered through ports designated for the entry of foxes as follows: Boston, Massachusetts; New York, N. Y.; Rouses Point, N. Y.; Calais, Maine; Pembina, North Dakota; and Seattle, Washington.

They must be accompanied by an affidavit made by the owner or importer declaring clearly the purpose for which the foxes are imported, viz, whether for breeding purposes or for zoological gardens or other institutions. Feed, attendants, and quarantine will be at the expense of the owner, and each owner or his agent shall give satisfactory assurance to the inspector at the time of admission to quarantine that such provision will be made. The place of quarantine, its construction, arrangement, and equipment will be subject to the approval of the Bureau of Animal Industry.

The demand for fur and the attractive prices which it commands has interested many people who are favorably situated to breed fur-bearing animals. A number of fox farms have been established in the northern states. To encourage this work and to guide those who undertake it, the department has published Farmers' Bulletin 795, the Domesticated Silver Fox; and Yearbook Separate 693, Fur Farming as a Side Line; and Department Circular 135, Maintenance of the Fur Supply.

THE SILVER FOX RANCH AT LAKE TAHOE, CALIFORNIA.

Mr. William Lewis, of Lake Tahoe, returned from a trip east last October with ix splendid specimens of registered silver black foxes to add to his ranch. These were all purchased from the Borestone Mountain Fox Ranch of Onawa, Maine, after careful inspection of the best

ranches in Canada and the United States. The present investment is still further proof of Mr. Lewis's confidence in this most interesting breeding industry. His ranch is at Pomin's, in a beautiful situation on the shore of Lake Tahoe. It has been built according to the most modern methods and is today probably the most up to date ranch in the west, containing nothing but high-grade registered stock.

Mr. Lewis believes in purchasing animals only from such high type blood-lines as have actually proved their value in competition. It was for this reason that he purchased all his stock this year from the Borestone Mountain Ranch, which the recent fox shows have proved is the leading ranch of North America. Mr. Lewis reports that this ranch is on the top of a mountain in an ideal situation in the heart of the Maine woods. But the fundamental reason the Borestone foxes are today the champion prize winners over all other foxes, Canadian or American, is due to their careful breeding. Their owner, Mr. R. T. Moore, a graduate of Harvard and the University of Pennsylvania, has made a study of the breeding methods, employed in the development of our famous race horses and registered live stock and has applied them to the improvement of foxes.

That these methods have been successful has been proved at the big fox shows, held in the East, at Boston, Montreal and Muskegon, during the past two years. At the very first live fox show the Borestone foxes swept the prizes, winning as many ribbons and cups as were won by any three competitors. A pup, eight months old, Borestone Sirius, was awarded the grand championship over all the adults. Among his competitors was the brother of "Reid," a fox that subsequently won the championship of the Montreal Show in 1920, and is owned by Mr. Moore.

At the much larger show held in Boston last December, the Borestone foxes again triumphed, winning fourteen ribbons and five of the eight silver cups offered for thoroughbreds. Of the three remaining cups, one was awarded to the Borestone ranch, but was refused by the owner, as he had offered it himself, and a Borestone fox tied at 93¾ points for the other two. In addition a fox born on the Borestone ranch, "Borestone Loami," was awarded the highest score in the show, 96 points, winning two silver cups and the nternational Championship of North America. In the field against her were one hundred and fifty foxes and forty of these were of the best Canadian strains, seven of which had already won prizes at the Montreal Show. One of these defeated oxes, subsequently, won the grand championship of the Muskegon Show, where the Borestone foxes were not entered. Mr. Moore now owns the grand champions of he three big fox shows and the only two foxes, that have ever been awarded 96 points or more:

Borestone Loami 96 points, International Champion, Boston, 1920.

Borestone Reid, 96 points, Grand Champion, Montreal, 1920.

Borestone Sirius, 93 points, Grand Champion, Boston, 1919.

Nearly every fox purchased by Mr. Lewis is closely related to these famous animals, or to the other eleven prize winners, of the Borestone ranch. His "Tahoe Loami" is a daughter of the famous "Borestone Loami," his "Tahoe Otto" is a half brother of the same fox, and "Tahoe Lone Star" is a nephew of "Sirius" and also of "Borestone Rigel" 94½ points, champion pure black fox. With such stock the Tahoe ranch has a splendid foundation, and under the ideal conditions at Tahoe will no doubt make a plendid showing.

Fox breeding today is beyond the exerimental stage. It has been placed upon sure foundation by the progressive work f the American Fox Breeder's Association. Until this association was formed t was impossible for a novice to tell the difference between poor foxes and good ones. Many inferior animals were sold at fabulous prices by unscrupulous fox raders and promoters. This will no onger be possible, if the prospective fox breeder will take advantge of the opporunities, provided by the American Association, for him to differentiate between good and bad stock. First of all, they have established a standard of perfection, by which a fox may be judged. Second, they created an advanced registration system, by which all superior foxes, that should attain 85 points or more under the standard of perfection, could be registered as of undoubted first quality. Third, due to Mr. Moore's enthusiastic

promotion and energetic effort, despite the cold water thrown on the movement by the older breeders, the first live silver black fox show was held in Boston. It was a complete success both financially and otherwise. The Canadian government sent the chiefs of their department of conservation to it, to consider the possibilities of holding a similar show, and the Montreal show of 1920 was the result.

As a consequence of these innovations, the prospective purchaser can now be sure of getting really first quality foxes for his money. He should insist that the parents of his foxes are, not only pedigreed and registered animals, but that they are also in the advanced registered class. Better still, he should, if possible, attend one of the big fox shows and there see for himself what kind of foxes are awarded the prizes.

The American Association is really a national organization, for the members of its board of governors hale from all parts of the country. Recently Mr. Lewis has been honored by being made a governor of this association. Through him it will be possible for all fox breeders of the extreme West to keep in touch with the American Association and the latest developments in this fascinating new industry.—J. H. SANDERS, *Truckee, Calif.*

WILD FOWL NEED PROTECTION AND FEEDING GROUNDS.

Although legislative measures for the protection of wild fowl have multiplied, and have added to the restrictions on hunters, these regulations have not been sufficient to maintain these game birds in their former abundance. Regions that once were the summer homes of myriads of wild ducks have been drained and placed under cultivation, and extensive areas where the birds at one time bred are now populous farming communities. These changes, say biologists of the United States Department of Agriculture, have crowded out the former feathered residents and have served in a corresponding degree to reduce their numbers. Realization of these facts has led recently to the adoption of other measures to encourage waterfowl. A number of extensive marsh areas have been made permanent refuges under the guardianship of the Department of Agriculture, and many private preserves, some formed by artificial means, have been established where the birds are protected while nesting. In addition, in a number of cases, rigid local restrictions have been placed upon hunters.

As a means of cooperating in such efforts to maintain and increase the numbers of waterfowl, the Biological Survey of the United States Department of Agriculture has undertaken investigations of the general conditions under which wild ducks live and thrive, coupled with counts of the birds found in areas varying in character. During three summers, field studies were made dealing with wild ducks in the Bear River marshes in Utah, a report of which has just been published by the department in Department Bulletin 936, Wild Ducks and Duck Foods of the Bear River Marshes, Utah.

During the three seasons devoted to this work, twelve species of ducks and the Canada goose were found breeding in the region included in the Bear River marshes, which covers an extensive area at the northern end of Great Salt Lake. In an enumeration made during May and June, 1916, of the eleven species of breeding ducks, 3,650 pairs were counted, and it is believed that this number represents between 60 and 100 per cent of the total number of breeding ducks occurring there that season. Allowing five young reared to maturity as the average for each pair, and considering 1916 as an average season, the bulletin states that, at a conservative estimate, between 25,000 and 30,000 wild ducks, native to the marsh, are to be found there at the close of the breeding season.

It was found that, in addition to the large number of birds reared on the Bear River area, many other ducks came in after the nesting season to remain there until fall. That birds from the Bear River section range widely after leaving these marshes has been shown by records of ducks that have been banded and released there and subsequently were shot elsewhere. Records thus obtained show that birds released near the mouth of Bear River in migration cover the region from Oklahoma to Texas and west to California. The department urges the establishment of a greater number of preserves where

wild fowl may breed and rest unmolested, and find an ample supply of food.—*United States Department of Agriculture.*

BIRD BANDING.

The first American to become interested in the banding of birds was the great nineteenth century naturalist, Audubon. Curious to know what became of the birds that flew south with the approach of cold weather, he put threads about the legs of a brood of phoebes that he had been watching and in the following spring was rewarded by having two of the birds return to nest near the haunts where they had learned to fly. Bird banding is not confined to the banding of non-game birds alone. In the United States Department of Agriculture Weekly News Letter, of June 1, 1921, there is the following interesting article on the banding of ducks:

When a wild duck decides to move from his summer home in Canadian wilds he neglects to leave a forwarding address to indicate where his winter quarters are to be established. The Bureau of Biological Survey, United States Department of Agriculture, is working on a method to offset the duck's carelessness. This consists of a system of trapping the birds and marking them with aluminum leg bands that carry a number and the legend "Biol Surv., Wash., D. C." When a banded duck is killed, the hunter removes the band and returns it to the Biological Survey with information showing when and where the bird was recovered.

During the past autumn a Canadian collaborator of the Survey, Mr. H. S. Osler, operated a duck trap at Lake Scugog, Ontario, where he captured and banded over 200 black ducks and mallards, with a few ring-necked ducks and blue-winged teals. Some of these were killed near the place where they were banded, but others were from such localities as to indicate approximately the route taken by these birds in their journey to the Southland. In all, about 25 of Mr. Osler's ducks have been killed and the bands returned from points in Ohio, Indiana, Kentucky, Tennessee, Arkansas, Mississippi, Louisiana, and Texas. One of the blue-winged teals was killed near Port of Spain, Trinidad, British West Indies, more than 2,500 miles from Lake Scugog, where the band was attached.

The systematic banding of birds, as undertaken by the Biological Survey, will furnish conservationists with much valuable information.

FACTS OF CURRENT INTEREST.

Deputies Clark and Burke arrested six Japanese near Pigeon Point, San Mateo County, for having 150 undersized abalones in their possession. These men were notified to appear before Judge Ray Griffin, which they did, and were fined $100 apiece.

* * *

Mr. Jay Bruce, state lion hunter, succeeded in killing nine mountain lions during the first three months of the year, as well as three bobcats.

* * *

Deputy Von Arks made cases last year within a five-mile radius of his home, in Sonoma County, which brought in fines aggregating thirteen hundred dollars. Deputy Von Arks evidently believes in cleaning up his home town first.

* * *

During February and March there was a round up of violators of the fishing laws in district twelve. Sixteen men were arrested of whom six were convicted, the fines totaling $695. Four nets totaling 667 fathoms were confiscated. Two of them were sold and netted $145. During March deputies O'Connell and Newsome confiscated seven nets, totaling 2295 feet, which were being illegally used in a closed district.

* * *

Deputies Groves, Lencioni, and Von Arks, working the coast between Russian Gulch and Wallalla at low tide, arrested sixteen violators for having in possession undersized abalones. The offenders were taken before Judge Charles of Sea View and the fines will aggregate over seven hundred dollars. The largest fine was one hundred and twenty-five dollars, which was awarded a market fisherman. The small sized abalones confiscated totaled several hundred.

HATCHERY NOTES.

W. H. SHEBLEY, Editor.

As the egg-collecting operations at the various hatcheries have not been entirely completed yet, we are, consequently, unable to definitely submit the number of trout fry which will be available for distribution from the various stations during the coming season. We anticipate that the output from all of the hatcheries of the state for the year 1921 will be approximately 25,000,000 trout fry. If the number of trout fry actually distributed even approximates this figure, it will be the largest distribution of fry ever made in one season in the state.

Due to adverse climatic conditions in some sections of the state, we did not take as many eggs at the spawning stations as we had anticipated; but this partial failure is, in a great measure, offset by favorable situations obtaining in other districts.

MOUNT SHASTA HATCHERY.

From present indications, we will have for distribution from Mount Shasta Hatchery this season, approximately 11,000,000 trout fry consisting of rainbow, Loch Leven, German brown, eastern brook, steelhead, and possibly a small number of black-spotted trout fry.

The Loch Leven and German brown and practically all of the eastern brook trout eggs were taken from the adult fish kept as a breeding stock in the Mount Shasta Hatchery ponds. The rainbow eggs were received from the several rainbow egg-collecting stations located on tributaries of the Klamath River, Siskiyou County.

In addition to the rainbow eggs hatched at the Mount Shasta Hatchery, a sufficient supply of eggs of this specie were received to permit of shipments being made to Mount Whitney, Ft. Seward, Kaweah and Wawona hatcheries. The supply of steelhead trout eggs which is being hatched for distribution from the Mount Shasta Hatchery was received from the Brookdale and Ukiah hatcheries.

The two fish distributing cars are in the shops of the Southern Pacific Co., at Sacramento, being overhauled and placed in first-class condition for the season's operations. The work on the two cars is practically completed and at least one car will be ready for commencing the season's operations on or about June 1.

Distribution operations from the Mount Shasta Hatchery will be commenced nearly a month earlier than is usually the case. It was essential that we commence this work earlier than in former years owing to the greater number of trout fry which we will have to distribute from that station this year.

As mentioned in a previous issue of CALIFORNIA FISH AND GAME, there were hatched at the Mount Shasta Hatchery this season nearly 6,000,000 chinook salmon eggs, which were received from the Federal Bureau of Fisheries' station at Mill Creek and from our own salmon egg-collecting station at Klamathon, on the Klamath River. As soon as the oldest of the salmon fry were of suitable age for planting, they were distributed in the head waters of the Sacramento River and the balance of 3,000,000 were removed from the hatching troughs and placed in the three large salmon rearing lakes on the Mount Shasta Hatchery grounds. These fry will be fed and held over the summer and released in the head waters of the Sacramento River during the fall months.

FALL CREEK HATCHERY.

Rainbow egg collecting operations at the Fall Creek Hatchery were very successful, there being nearly 1,000,000 eggs of this specie collected. Approximately 600,000 of the eggs have been hatched and will be held throughout the summer months and distributed in the Klamath River at the proper season. The balance of the eggs were shipped to the Mount Shasta Hatchery to be hatched and reared for distribution in other localities of the state.

In addition to the rainbow trout hatched at Fall Creek station, 3,000,000 of the salmon eggs collected at Klamathon Hatchery last fall were hatched and are being reared for distribution in the Klamath River. A portion of the fry will be planted during the late spring months and the balance will be held in ponds constructed for the purpose last summer, and

one additional pond which is now in course of construction. These fish will be held and fed throughout the summer and distributed in the Klamath River next fall.

BOGUS CREEK STATION.

Bogus and Camp Creek egg-collecting stations have been closed after completing the most successful season since the stations have been established. Over 6,000,000 rainbow trout eggs were collected from these two stations during the season which has just closed. All of the eggs collected were shipped immediately to the Mount Shasta Hatchery for incubation. During the summer some minor repairs and improvements will be made at these plants in order that they may be in readiness for operations next season.

HORNBROOK STATION.

The Hornbrook station was operated during the past season, but the number of eggs collected was far below the normal take, less than 200,000 eggs being taken during the entire season. This was due to the fact that the flood waters of the early part of the spawning season changed the course of Cottonwood Creek, forming a sandbar between the old mouth of the stream and the new cut, which prevented the trout from entering the stream to spawn. Prior to the cutting of the new channel, the flood waters were entirely over the top of the racks, thus permitting the first part of the run of spawning fish to pass on up the stream. The small number of eggs taken were received from the few stragglers which came up the creek through the old channel.

Before the station can be successfully operated, it will be necessary that considerable work be done in opening up an adequate channel to permit the fish to ascend the stream at the mouth of the creek.

MOUNT WHITNEY HATCHERY.

During the early part of December, 300,000 Loch Leven trout eggs were shipped to Mount Whitney from Mount Shasta Hatchery and during the first part of April, 500,000 rainbow trout eggs were shipped from the same station. Shipments of steelhead trout eggs to the number of 800,000 were made to the Mount Whitney Hatchery from Brookdale Hatchery. The fry resulting from these three shipments of eggs are developing into fine, healthy fish, and will be ready for distribution early in the summer.

Further shipments of rainbow trout eggs will be made from one of the other stations and we are also contemplating opening up the Rae Lakes rainbow egg-collecting station. All eggs received from this source will be immediately transported to the Mount Whitney Hatchery, where they will be hatched and reared.

LAKE TAHOE HATCHERY.

The new Lake Tahoe Hatchery, which was completed last fall, was opened for operations on May 14. A shipment of black-spotted trout eggs was taken to the hatchery on that day from the new egg-collecting station established on Blackwood Creek. Other shipments of black-spotted eggs will be forwarded as the eggs are taken at Blackwood Creek. Shipments of steelhead trout eggs from the Brookdale and Ukiah hatcheries have been shipped to the Lake Tahoe Hatchery, and within the next two or three weeks rainbow eggs will be shipped in from one of the rainbow egg-collecting stations.

MOUNT TALLAC HATCHERY.

Mount Tallac Hatchery was opened for operations during March. As in former years, seining operations were conducted at the mouth of Taylor Creek, for the spawning trout from which are obtained the black-spotted trout eggs.

In addition to the egg-collecting operations conducted off the mouth of Taylor Creek, an egg-collecting station was established on the upper Truckee River. The stream was racked, and a trap, tank, etc., were installed. The results obtained from the operations to date have been very satisfactory.

As above mentioned, a station was put in operation at Blackwood Creek and the eggs received from this plant are incubated at the Mount Tallac Hatchery and the new Lake Tahoe Hatchery. One million black-spotted trout eggs have been taken to date.

FORT SEWARD HATCHERY.

The 500,000 chinook salmon shipped to Fort Seward from the Mount Shasta

Hatchery during February were hatched and the resulting fry distributed in Mad River, tributaries of Humboldt Bay, Eel River and other waters of Humboldt County. This was done during the month of April. Two hundred and fifty thousand rainbow trout eggs were shipped to Fort Seward from Mount Shasta Hatchery on May 16, and the resulting fry appear to be strong, vigorous fish. Over 800,000 steelhead eggs were shipped in from Ukiah Hatchery and these, together with the rainbow fry, will be given a wide distribution in the waters of Humboldt, Mendocino and Trinity counties during the coming summer.

SNOW MOUNTAIN STATION.

Steelhead egg-collecting operations at the Snow Mountain egg-collecting station did not prove to be as satisfactory as was anticipated. While there was a fair rainfall in that section this season and other climatic conditions were favorable, the usual number of steelhead spawn fish did not reach our station. Consequently, we were unable to take the usual large number of eggs. Approximately 2,000,000 eggs were taken as a result of the entire season's operations. We had expected to receive not less than 4,000,000 and possibly 5,000,000 or 6,000,000. A thorough investigation as to the reason for the failure of the spawning fish to ascend the stream to the Cape Horn dam, where our station is located, resulted in our finding that the stream had been blocked by fences, cleverly arranged in the Eel River, some distance below our stations. These had been constructed by persons who wished to prevent the fish from ascending the stream, in order that they might catch them. Those responsible for this outrage should be prosecuted to the full extent of the law, particularly since the legislature has just passed an act making it unlawful to bar the passage of fish by any weir, fence or obstruction.

The eggs taken at Snow Mountain station, with the exception of about 200,000, which were hatched for distribution in the upper waters of the Eel River, were immediately transported to Ukiah Hatchery.

UKIAH HATCHERY.

The Ukiah Hatchery was opened for operations on March 19. A total of 1,859,000 eggs were received from the Snow Mountain station. These were yed and shipments made to the Fort Seward, Mount Shasta and Lake Tahoe hatcheries. Between 500,000 and 600,000 teelhead eggs will be hatched at Ukiah Hatchery for distribution in the streams f Mendocino and Sonoma counties.

SCOTT CREEK STATION.

Egg-collecting operations at Scott Creek tation have been the most satisfactory ince the station was established. Three million steelhead trout eggs have been colected and operations have not as yet been ompleted. There will probably be somehing over 100,000 eggs yet taken. All eggs were transported to the Brookdale atchery as soon as the fish were spawned.

BROOKDALE HATCHERY.

As stated above, the Scott Creek station produced well over 3,000,000 steelhead trout eggs, all of which were transported to Brookdale Hatchery where they have been eyed and shipments of eggs nade to the Mount Shasta, Mount Whitney, Lake Tahoe, Wawona and Kaweah hatcheries. In addition to eggs shipped out to the above named stations from the Brookdale Hatchery, approximately 900,000 steelhead fry will be reared for distribution in Santa Cruz, Santa Clara and San Mateo counties. Arrangements are being made for the shipments to these three counties.

DOMINGO SPRINGS HATCHERY.

Domingo Springs Hatchery was opened or operations during the middle of March nd preparations were made for trapping he run of rainbow trout ascending Rice Creek to spawn. Severe storms in hat section made it very difficult for the nen to get into the station. They were bliged to go in over fourteen feet of snow n some places.

The heavy snow did considerable damge to the racks and traps at Domingo Springs Hatchery, and also to the fish-culture equipment installed at the mouth o' Warner Creek last fall. It is our intention to operate at Warner Creek this eason, in conjunction with the Domingo Springs Hatchery, where all eggs secured rom the former plant will be incubated. At this date no eggs have been taken at

Domingo Springs or Warner Creek as the "run" of spawning fish from Lake Almanor is very late, but we anticipate a very successful take of eggs.

CLEAR CREEK HATCHERY.

The Clear Creek Hatchery was opened for operations during the middle of March, as were the Domingo Springs and Warner Creek stations. Egg-collecting operations are somewhat earlier at Clear Creek than at Domingo Springs and to date we have secured approximately 1,500,000 eggs. A portion of the eggs secured from the Clear Creek and Domingo Springs hatcheries will be hatched at these two stations to supply local streams with trout fry, and the available balance will be shipped to the new Feather River experimental station.

FEATHER RIVER EXPERIMENTAL STATION.

As mentioned in a previous report, we are establishing an experimental hatchery on Jamison Creek, a tributary of Feather River. The station is located between Blairsden and Johnsville, in Plumas County. The purpose of establishing a station at this point is to eliminate, to a great extent, the necessity of transporting trout fry from the Mount Shasta Hatchery to stock the waters in this district, as well as the district along the Yuba River, in the vicinity of Sierra City.

Eggs will be shipped to this hatchery from the Domingo Springs and Clear Creek stations. The first shipment of 200,000 eggs was delivered from Clear Creek Hatchery on May 16. On May 14, a shipment of 100,000 steelhead trout eggs was received from the Ukiah Hatchery. The eggs appear to be in first class condition. As soon as the eggs commence to hatch, we will be better able to determine what the outcome of the experiment will be.

If there is no loss of fry or eggs, additional eggs will be shipped to the station and this large territory will be supplied with trout fry from the experimental hatchery during the coming season.

NORTH CREEK HATCHERY.

Egg-collecting operations at North Creek station have been very successful. Eggs have been collected from the large rainbow trout ascending North Creek, Metcalf Creek, and Grout Creek from Bear Lake, and while operations at present are not complete, we expect to take 2,500,000 rainbow trout eggs this season. One million five hundred thousand eggs will be transferred from the North Creek Hatchery to the Bear Lake Hatchery, at Green Spot Springs, from which station the resulting fry will be distributed during the coming summer in Big Bear Lake and various streams of San Bernardino County. The North Creek Hatchery will also be operated to full capacity. The fry reared at this plant will be distributed in Big Bear Lake also. We also expect to have a couple of small shipments of eggs to send to the Mount Whitney Hatchery where they will be hatched for distribution in other waters of southern California.

WAWONA HATCHERY.

Three hundred thousand rainbow eggs, and 100,000 steelhead trout eggs from Brookdale Hatchery, have been shipped to Wawona from the Mount Shasta Hatchery and the resulting fry will be distributed in Merced River and other streams of that section during the coming summer.

Previous to opening the Wawona Hatchery for operations on April 23, certain necessary repairs were made to the flume and water distributing system at the hatchery. All the repairs could not be finished this spring, consequently, we will have to complete the work after the fry have been distributed during the summer.

KAWEAH HATCHERY.

Owing to the fact that we were unable to proceed with the construction of the permanent hatchery on the Kaweah River, it was necessary that we again operate the small experimental station established three years ago near the town of Hammond. Three hundred thousand rainbow and 100,000 steelhead trout eggs were shipped to Kaweah Hatchery and the resulting fry will be distributed in the waters of Tulare County, as has been our practice during previous seasons.

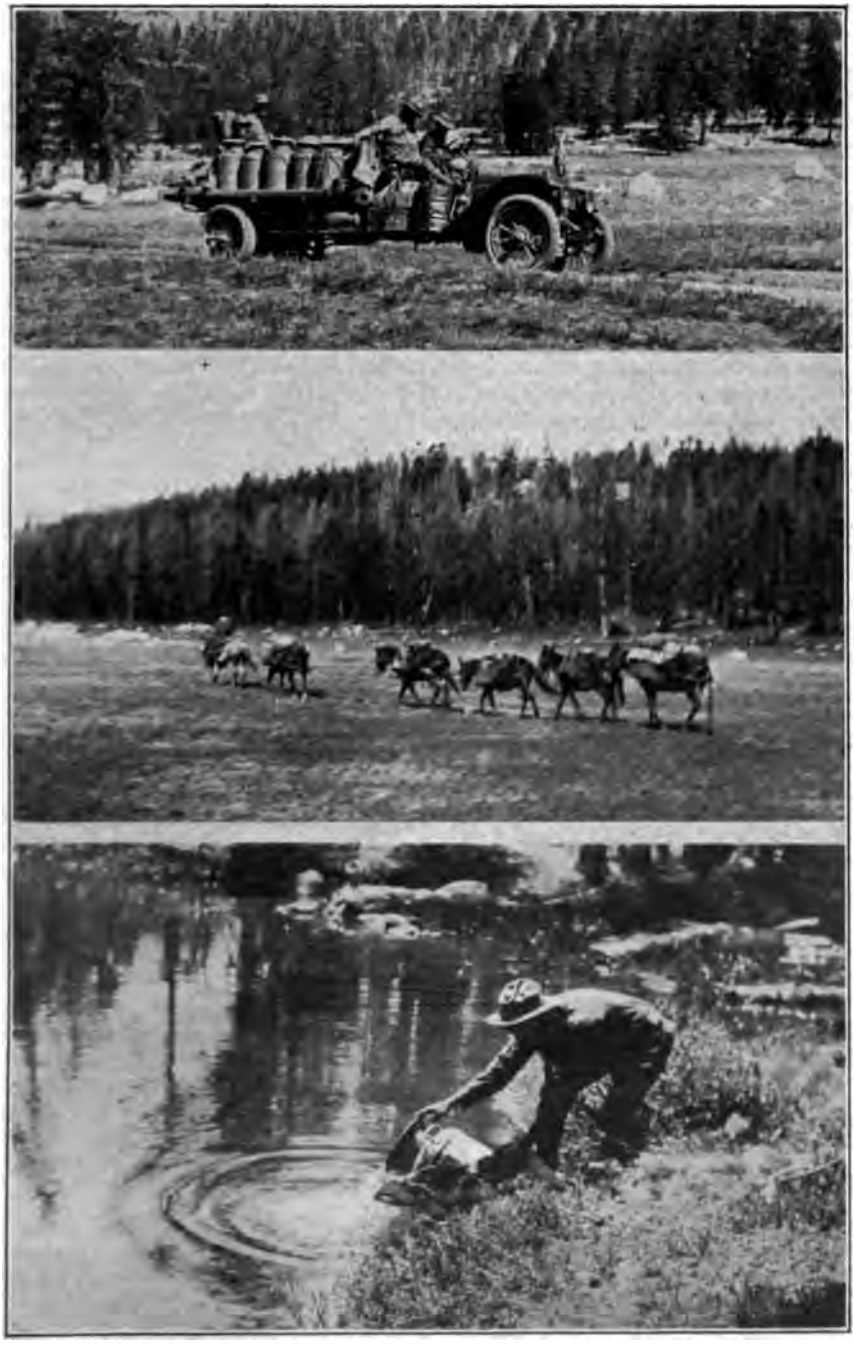

Fig. 53. Planting trout in Yosemite National Park; necessitating transportation by rail, motor truck and pack train. Photographs by H. C. Bryant.

Assembly Bill No. 832. By Mr. Stevens.

Salmon.

Amends section 634 of the Penal Code.

This bill is of importance for it places further restrictions on the taking of salmon which show that they are in need of additional protection. The suggestion for salmon conservation made in the last issue of CALIFORNIA FISH AND GAME were largely followed in this bill. The rapid increase in the catch by outside sea trolling, left the salmon insufficiently protected. It was the object in this bill to cut down the catch about equally in all districts and not cut down the river catch alone as suggested by the outside trollers, or cut down the outside catch alone as suggested by the river fishermen.

The upper Sacramento River district 12 A netting season was reduced fifteen days so that the open season for that district is the months of January to April, inclusive. For the balance of the river, the fall netting season was closed eight days earlier. These eight days are taken from the time when the run is heaviest and amounts to much more than the short time would indicate. This provision will cut down the river catch a little over 10 per cent.

A closed season is provided for Monterey Bay of January, February and March, which will cut down the catch in pounds at that point about 10 per cent. As this season comes at a time when small, immature salmon are taken in numbers the saving in numbers of fish is more than the saving in weight indicates. A closed season from March 1 to April 15, is provided for district 10 and a closed season of March and April for district 7. These two last are outside trolling districts and the closed season is to protect the immature salmon which are caught at the beginning of the season.

The bill provides that Eel River be closed to the use of nets after January 1, 1922, but permits the commercial taking of salmon on the lower river by trolling during the months of September, October and November.

Assembly Bill No. 1015. By Mr. Benton.

Croakers, Halibut and Barracuda.

Amends section 628 *e* of the Penal Code.

Prohibits the sale of California whiting, yellow-fin and spot-fin croakers. The sale of California halibut under four pounds in weight, or of barracuda under three pounds in weight or of albacore under six pounds in weight is prohibited as in the old law. In addition to the non-sale of these last three kinds of fish, this bill prohibits the possession of over fifty pounds of undersized fish.

FISHERIES NOTES FROM SAN PEDRO

Eight fishermen were arrested and convicted during April and May, 1921, for violations of the state fish laws pertaining to district 20. One of the heaviest fines imposed was meted out to Tony Marincovich, a San Pedro fisherman, in the justice's court at Avalon, Catalina Island, on May 13, 1921. Defendant in this case was fined $500 with the suspended jail sentence of one hundred days for maintaining a net in district 20 in violation of section 636.

The first albacore taken by a local boat this season was brought to San Pedro on June 8. Six fish averaging about sixteen pounds each were taken with jig lines.

The new fireproof cannery of the Halfhill Packing Corporation, recently completed on Channel 3 at Long Beach, is being put in readiness for the tuna season. In the meantime this company will pack chicken.

A decision that may affect the common practice by canneries in receiving tuna "subject to condition after cooking," was given by Superior Judge C. S. Crail at Department 4 in Los Angeles on June 9, in action brought by the crew of the "Golden Gate" for fish refused as unfit for canning purposes. Judgment was granted in favor of the plaintiff for seven and one-half tons of spoiled fish. This decision may result in fishermen taking more care with their catches on account of the possibility of canners refusing any fish that looks doubtful.

The boat "Kotobuki," Captain M. Yamamoto, arrived in San Pedro on June 13, with eight and one-half tons of seaweed (*Gelidium sp.*) taken in Mexican waters. The entire load was consigned to the American Agar Company in Glendale, California, which company is en-

gaged in manufacturing agar-agar. This seaweed was taken near Point Banda in approximately three to four fathoms of water by means of hooks attached to long poles.

PACIFIC FISHERIES SOCIETY MEETING.

The Pacific Fisheries Society will hold its annual meeting at the University of California, Berkeley, on August 4, 5 and 6. Some interesting papers will be read and discussions held on the development and conservation of the commercial fisheries as well as on the subject of sport fishing. The meetings will be of interest to those engaged in the fishing industry as a business, as well as to those interested in problems of conservation, for an effort will be made to get these two factions into close touch with each other. The final program will be announced about the middle of July. Some of the papers will cover the following subjects: Whales and Whale Fisheries of California; Seals and Sea-lions of California and their relation to the Fisheries; Fisheries Investigations of the California Fish and Game Commission; Future of the Pacific Coast Salmon Industry; Relation of Hydro-electric Power Development and Irrigation Projects to the Salmon Industry and to Trout Fishing; Fish Canning and Inspection; Fisheries Schools, etc.

The affiliated societies of the Pacific Division of the American Association for the Advancement of Science will also meet at Berkeley during these three days. The public is invited to these meetings. Papers relating to the fisheries will be given before several of these societies and any one attending the meeting of the Pacific Fisheries Society will have an opportunity to hear them.

Saturday, August 6, will be given over to many field excursions to visit places of scientific interest and to visit the local fisheries. Further information may be obtained from the secretary of the Pacific Fisheries Society, Mr. George F. Sykes, Corvallis, Oregon, or from the Department of Commercial Fisheries of the Fish and Game Commission at San Francisco.

STATE FAIR EXHIBIT OF FISHERIES

The Fish and Game Commission has secured twenty-four by forty feet additional space in the main exhibit building at the Sacramento State Fair and will enlarge the scenic and live fish display which has been one of the most attractive exhibits at the fair during the past two years. An area of sixteen by forty feet will be devoted to an educational exhibit of the state's fisheries resources and to the fisheries conservation work of the commission.

NOTES FROM THE STATE FISHERIES LABORATORY.*

WILL F. THOMPSON, Editor.

THE PERSONNEL.

The Fish and Game Commission has lost the services of Miss Helen M. Edwards, who married Mr. Samuel Bacon the latter part of April. Miss Edwards has been acting as scientific assistant to Mr. Thompson during the stay at Hopkins Marine Station, Pacific Grove. Her

*California State Fisheries Laboratory, Contribution No. 28.

The listing of small publications of members of the laboratory force together with the Fish Bulletins issued by them has led to some confusion. Hereafter these will be numbered as sent to the printer, not according to the date of printing. The correct numbers are as follows:

Fish Bulletin No. 4, contribution No. 22.

The Future of the Sardine, California Fish and Game, Volume 7, No. 1, contribution No. 23.

Notes from the State Fisheries Laboratory, in California Fish and Game, Volume 7, No. 1, contribution No. 24.

The Abundance of Young Pismo Clams, in California Fish and Game, Volume 7, No. 2, contribution No. 25.

Quarter-oils or Half-pound Ovals, in California Fish and Game, Volume 7, No. 2, contribution No. 26.

Whales and Sardines, California Fish and Game, Volume 7, No. 2, contribution No. 27.

place will be hard to fill, but nevertheless, the best wishes of all with whom she has been connected in her work go with her.

Besides Miss Edwards, the commission has had Mr. Thompson and Mr. W. L. Scofield at the Hopkins Marine Station during the past year, pending the construction of the new laboratory at San Pedro. In anticipation of the beginning of building operations, Mr. Thompson has transferred his residence to San Pedro. This has somewhat crowded the quarters there as they are now constituted, but it is hoped that this will not be permanently the case. Mr. W. L. Scofield has also left the Hopkins Marine Station, going to Palo Alto, where he will work at Stanford University for several months. This leaves no one at present in Pacific Grove. The Fish and Game Commission owes much to the Marine Station for the space kindly granted its workers.

During the coming summer, Mr. O. E. Sette will be engaged in work for the commission in continuation of his sardine studies which he has been pursuing at Stanford University. He will make his headquarters at San Pedro with the other members of the laboratory staff.

THE LIBRARY FOR THE NEW LABORATORY.

The work of collecting a library for the scientific work to be carried on in the new laboratory has been under way some time. There have been many difficulties in the way, such as the unsettled conditions in Europe, the determination of the method of purchasing such periodicals as are desired, etc., but it is now hoped that the more serious of these have been overcome. There are now on our shelves the complete publications of the Scottish Fishery Board, together with those of the Irish and British governments; the Reports and Bulletins of the Bureau of Fisheries of the United States; the Reports of the Dove Marine Laboratory; the Danish, Dutch and Norwegian government publications; those of the Canadian government; of the states of Rhode Island and Massachusetts; of the Province of British Columbia; and many separate volumes bearing on fishery matters. We have to thank the Dove Marine Laboratory, Prof. E. E. Prince of Canada, the Danish, Dutch and the Norwegian Fishery authorities for their generous donation of literature. There are now well toward completion the negotiations for the purchase of all the well-known scientific journals which are specially devoted to the subject of fisheries, and it is hoped that by the time the next issue of CALIFORNIA FISH AND GAME appears, we will be able to record the arrival of many of these. The low exchange value of the money of various European nations has rendered the purchase much less expensive than would have been the case previous to the war.

It is unfortunate that some of the sets obtained, notably that of the Bureau of Fisheries of the United States, are somewhat incomplete because certain numbers are out of print. We greatly desire to obtain these, however, and would be much obliged to anyone assisting us by the donation of odd issues of the various sets we may desire.—W. F. T.

THE BASKING SHARK AT MONTEREY

The Basking Shark, known to science as *Cetorhinus maximus*, has been recorded several times from Monterey, but its occurrence is nevertheless an interesting event, especially to the fishermen. This giant shark, with its gill openings extending well around toward the front of its throat, always attracts much attention when brought ashore. At Monterey it is usually taken in the lampara or gill nets, in which it becomes entangled until it is supposed to smother to death by the closure of the gill openings. It does great damage to the net in the meanwhile, and the fishermen do not welcome it. On May 3, 1920, a specimen was brought in to the wharf at Monterey, and measured by W. L. Scofield, who found it to be twenty-two feet long from the tip of the snout to the end of the tail. Again, in April, 1921, a specimen twenty-four feet in length was brought in by a lampara fisherman. In the endeavor to recoup some of the loss caused by the damage to his nets he exhibited the great shark for an admission charge. It is said that he failed in the venture.—W. F. T.

A RAG FISH AT MONTEREY.

There are several "rag" fishes found on our coast, one of which is hereby noted as occurring at Monterey. Mr. Higgins has had the good fortune to find a still rarer member of the group, and describes it below. The specimen found at Monterey was *Icosteus aenigmaticus* of Lockington. It was taken during 1919, but the date and place of capture, save that of Monterey Bay, was not recorded. The specimen at hand is twenty-three centimeters in body length, and twenty-seven and three-tenths in total length.

The salient characters of this "rag" fish are its lack of stiff bones, which makes it much like a thick, flat, bundle of rags, its yellowish color with purplish spots of irregular shape, and the row of spined scales along the lateral line. The fin rays are all of them covered by small spinules. It is very evidently a fish from the deep water, but just what depth we cannot surmise. It may be a pelagic.—W. F. T.

A STRANGE RAG FISH AT SAN PEDRO.

Closely related to the family of rag fishes, of which *Icosteus* is the typical genus, is the little known species, *Acrotus willoughbyi*, Bean. A specimen was taken in a mackerel net off San Pedro, March 31, 1921, and brought to the wholesale markets. We were unable to obtain the specimen as it was sold for exhibition, but careful measurements were made and there can be little doubt of its correct identification.

The fish was fifty-seven inches long, fourteen inches deep, and rather flattened laterally. The body was very limp and yielding as in other members of this group, due to the cartilaginous nature of the skeleton, the flesh was soft, and the naked skin tender and easily broken. The mouth was large, with thick lips, the nose broad and rounded, resembling with its large nostrils the muzzle of a calf. The fish was so fragile that it was somewhat mutilated when it reached the market, the gaff having torn through the jaw when landing the fish from the net.

The first or type specimen was taken in 1887 on the coast of Washington, apparently thrown up from deep water in a storm. Another was taken there subsequently, and one was taken at Monterey. This occurrence is especially noteworthy as the species has rarely been seen by naturalists and has never before been taken on this part of the coast.—E. H.

CUTLASS FISH TAKEN OFF LONG BEACH.

Following the practice of noting the unusual, the occurrence of the cutlass fish, *Trichiurus lepturus*, Linnaeus, which has recently come to the notice of the laboratory staff, entirely incidental to the regular work, may be here recorded.

Two specimens were taken, one on the first and another on the fourth of January, 1921, off Long Beach, in from three to five fathoms of water. They are each about two feet long, one and three-quarters inches deep, and very much compressed laterally. The mouth is large with long sharp teeth, the eyes large, and the skin is naked and of silvery color. The dorsal fin extends the length of the body to the long thread-like tail.

The species is common in the West Indies, and has been reported on the Atlantic coast as far north as Cape Cod. It is known in the Pacific from Panama, Lower California, and Japan, but this is probably its first appearance in this region.—E. H.

THE GRUNION.

The traditional spring spawning runs of the grunion on the sandy beaches of southern California have created the usual excitement at Long Beach this spring. These little fish, as described by Mr. Will F. Thompson in Fish Bulletin No. 3, come up on the beach with the high tides of the second, third and fourth nights following the full moon of the spring months, to deposit their eggs in the sand away from their enemies in the ocean. Although the deposited eggs are free from most enemies, great numbers of the spawning fish are taken by the "grunion hunters," who gather on the beach at about high tide and capture the fish as they are left on the sand between waves.

On March 23, the first night upon which a run might be expected, no fish were observed to be spawning. No observations were made on the two following nights, but during the second scheduled run, April 24, 25 and 26, large runs were observed on all three nights.

Runs were also reported to have occurred during the high tide of the new moon period early in May, but the extent and dates of these runs are not known. The full moon run in May, seemed to be a little out of the ordinary, as on the first night of the run, May 23, a considerable stretch of beach was carefully watched, but no spawning fish were observed, only a small number being seen in the surf. The presence of the fish in the surf was also made evident by the capture of quite a number by the use of a net in the shallow waves. On May 24, the run was but little better than that of the night before. The many people who scanned the beach were able to collect a few fish by wading out into the shallow receding waves, but very few fish were observed to be spawning. The results of a search for eggs in the sand on May 25, verified the conclusions from the observations of the two nights before, for only two pods of eggs were found as the result of quite extensive digging. The run of May 25 seemed to be normal in every way and many people who had searched the beach in vain the two previous nights were well paid for their efforts with a good supply of fish.—H. B. H.

LIFE HISTORY NOTES.

INTRODUCED DOVE THRIVES IN LOS ANGELES.

The Chinese spotted dove (*Spilopelia chinensis*), as a resident of Los Angeles first came to my attention in 1917, when a dead bird was found by school children in Hollywood. The skin of this specimen was preserved and is now in the museum of the Nature Study Department of the Los Angeles County schools.

At that time it was said to be common in a restricted locality in northern Hollywood. Reports of its occurence have increased in frequency and from a much wider area, until in the first week of April, a bird was noted by the writer, at close range, near the museum in Exposition Park.

Various reports as to the origin of this colony have not satisfactorily established whether the progenitors were liberated, or whether they were escaped cage-birds. The fact remains that the species is firmly established, and as a city-dweller, safe from hunters, is rapidly increasing in numbers.—L. E. WYMAN, *Museum History, Science and Art, Los Angeles, California.*

MOUNTAIN LION SWIMS RIVER.

It seems to be the general belief that the mountain lion is very shy of water, and that he will go out of his way in order to avoid crossing a stream when it is necessary for him to swim. My experience in trailing lions does not bear out this impression. In fact, two male lions which I killed at different times in Shasta County were voluntarily swimming the McCloud River, at different places, on every trip around their beat. Deer were as numerous on one side of the river as on the other, so it was not necessary for the lions to cross in order to get food. And as in each instance, the tracks were several hours old, it is apparent that these lions did not swim the river to confuse or avoid the dogs, but that they were merely following their natural instinct.

Another instance of this kind was in January, 1921, when I was hunting from Kinsley Ranger Station, Mariposa County, in the company of Mr. Joseph Dixon of the Museum of Vertebrate Zoology. After several days of storm, the weather cleared about dark on the evening of January 19. There was about six inches of snow on the ground when we left camp early on January 20. At about 9 a. m. we found the track of a large male lion on Grizzly Mountain. The tracks were about twelve hours old when we found them, which was indicated by the condition of the snow where the tracks were made.

On account of the dense brush in places we were unable to keep up with the dogs. As a result, by the time we had trailed the lion about six miles south to the north rim of the Merced River, and at a point about 2000 feet above the river, we

could just faintly hear the hounds baying as they crossed over the south rim, at about the same elevation. We hurried down the mountain to the river and soon found the tracks of the lion and dogs entering the water on a sand bar at about 600 feet west of the mouth of Slate Gulch and about three miles east of Briceburg.

I was sure that the dogs would tree the lion before night, so that I was determined to follow them, although Mr. Dixon had had to return to Berkeley. As the river was about 100 feet wide and too cold and swift to swim with safety, I decided to build a raft. I stopped a passing telephone lineman and got some spikes from him. Then I gathered some discarded railroad ties and driftwood and built a raft at the upper end of a pool. Using a piece of driftwood for a paddle, I ferried across. The dogs had crossed the river at about 12 o'clock noon and by the time I had built the raft and crossed to the south side it was 2:30 p. m.

I soon found the track of the lion and dogs climbing the mountain on the south side of the river. After trailing them about two miles up the ridge toward Filiciana, I heard the dogs barking "treed" in the head of a short canyon on the west side of Slate Gulch. When I arrived at the tree, the lion jumped out, but treed again about a hundred yards farther up the canyon. He was lying in the narrow fork of a tall live oak and when I shot him through the heart with the revolver, he sank into the fork and died.

Then I climbed the tree and tried to dislodge him, but as he weighed about 160 pounds, and as it was necessary to lift the carcass about four feet to slip the hips through the fork, I was unable to free him. I then thought of cutting off one of the forks with my skinning knife. By this time, it was getting quite dark and a storm was threatening, and with a hard, rough trip of two miles down the canyon and the river to cross, I decided to cut the carcass in two behind the shoulder and drop the front half to the ground, leaving the rear half in the tree.

By the time that I reached the river, it was quite dark and as the raft had drifted half way down the pool while I was crossing earlier in the day, I was forced to abandon the raft, on the return trip, near the north bank, and wade out to avoid being carried into the rapids. I now walked three miles down the river to Briceburg where I arrived about 8 p. m., after being on the trail fourteen hours.

This lion had crossed the river probably ten hours ahead of the dogs and was following his regular beat as I found his old tracks while trailing him on the south side of the river. There was also the skeleton of a calf near the place where the lion was treed. He had probably been killing cattle there during the summer.—JAY C. BRUCE, *San Lorenzo, California.*

CURLEW NUMEROUS.

Since its protection, the Hudsonian curlew (*Numenius hudsonicus*) is becoming more numerous again, in this vicinity. I have lived and hunted in this country around Rio Vista from boyhood and have entertained a number of the most prominent sportsmen from many states on my reserve, and I have naturally taken a keen interest in the wild game life of the locality. I have heard the old settlers here tell how the jack curlews were upon these plains in countless thousands at one time. Whether they were killed off or inhabited another region, I am unable to relate, but I do know that for the last twenty years at this season of the year we have only seen an occasional flock. However, about a week ago I noticed a flock of about one hundred of these birds on the pasturage grounds each day. The flock has been increasing until it has reached about five times its original size. On April 26, 1921, about sunrise, I saw a flock of about five thousand which all seemed to be whistling at the same time. I was greatly astonished, as I had never seen these birds in such numbers before. This large flock did not stop in this vicinity, but traveled straight on southward; and each day I have seen curlew still migrating to the south, but not in such great numbers. There are a great many here at present, yet they are not so numerous as they were a week ago. They are evidently traveling to a new feeding ground.—S. C. CHURCH, *Rio Vista, California.*

ALBINO DEER SEEN IN THE STANISLAUS FOREST.

On February 1, of this year, Ranger Freer saw a white or albino mule deer in the Stanislaus National Forest. Several months later, on May 7, when Ranger Freer and former District Ranger Fowler were out repairing telephone lines they again saw an albino deer. These two records of the appearance of an albino deer were of unusual interest to us.—J. V. WULFF, *Sonora, California.*

A TRAPPER'S EXPERIENCES.

I laid out my first line of traps on the twenty-fifth of October, 1920, stringing them from Logan Meadow north to the junction of the main and West Chiquito creeks, crossing here and keeping along the ridge until opposite Placer Station, where I crossed over and continued north to Arnold meadow. Then I crossed back to Logan via Mebold and Summit meadows, covering about thirty miles each day. Of course, I later varied this line in several respects, at one time running up the Joaquin to Squaw Dome, and again trapping the other side of the river as far down as Kaiser crossing.

My first catch, on the twenty-sixth of October, consisted of three grey foxes and one skunk. All of these skins were exceedingly blue and unprime, so I set all traps off that day and left them until the fifteenth of November, and even then I caught foxes that were not at all prime. In my mind there is not the slightest doubt but that the trapping season is at least one month too early even for that country; yet there are always trappers at work on the first day of the season (October 15) as low down as Finegold. Then they wonder at the prices which they receive for their furs.

For coyote bait I used squirrel meat ground very fine, to which I added a small amount of tincture of asafetida (God only knows how to spell that word—but you know what it is—I used to wear it around my neck to prevent diseases when I was a kid) and some oil of rhodium. I set three traps in a Y form, driving a stake through the rings completely out of sight, and covering the whole thing over very carefully. In the course of two months, I was able to so set such a group of traps that the coyotes would take enough notice of it to turn a trap over once in a while, or scratch the bait from the center of the set. I then found that they were suspicious of any set that was bounded on any side by any obstacle whatever—and after that I set them in the openings; and this was the secret of the whole game. I caught seventeen of these so-called coyotes in a very short time. A peculiar thing about them is that, while in the trap, at least, they will utter no sound whatever and, instead of striving to get away, they will simply grovel in the dirt like a domestic dog trying to beg forgiveness; also they will positively not meet your eye. On the contrary with the grey fox—they are continually on the prod and will growl, snap and bark from the time they see you until they are dispatched. I also caught a large black eagle in one of these sets, and he was as docile as a chicken, not even hissing at me when I let him out of the trap. Later I caught another of these birds, but the coyotes found him first and left me only his two feet.

I spoke to you about finding the carcasses of eight deer that had undoubtedly been killed by coyotes. These kills were always in the deep snow and one could visualize every move that was made. In each case the deer was chased by not more than two animals—sometimes only one—and caught by another as he circled back over his trail. I have always read that these animals hamstring a deer, but in so far as I could tell these deer were pulled down from in front by a nose hold, and when you take into consideration the size of these coyotes it does not seem at all impossible. My largest was sixty-two inches long and would weigh something over 100 pounds, but the average was better than fifty-eight inches from tip to tip, and just that much bone and muscle. In broad daylight I saw one carrying a full grown badger by holding it in his teeth and throwing the weight over his left shoulder. When caught in a trap they will tear manzanita bushes over two inches through into the smallest shreds. The one thing I couldn't understand about these killings was that they were all large deer and mostly bucks. It was some little time after the rutting season and after the bucks had plenty of time to regain strength. The last one I

found was about the twenty-fourth of February, and as I attempted to lift the head both horns came off in my hand. This for your information regarding the time deer drop their horns at that elevation. This was a perfect four-pointer.

During my stay in there I saw but one loin track, and though I followed for several miles I could not find where he had either attacked or molested any deer. I am, therefore, of the opinion that a great many of the kills with which lions are blamed should go to the coyote. J. T. Hogue told me that he had found a great many deer killed by lions in his time, but he admitted that he had seen no sign of a lion at a great many of these carcasses and had simply taken it for granted that it was a lion. When the Teafords were in there hunting lion and bear last winter they saw one lion track—this lion had come from Shake Flat across country to the Soda Springs on West Chiquito and straight through to Jackass—in a straight line and with never a stop, although he was passing through a country that literally swarmed with deer of all kinds. Certainly, at that time of year he was going straight through and out of the deer country, and though the boys followed him for two days he did not stop or make a kill of any kind. George Teaford and W. B. Day, both old-timers, tell me that they have seen deer killed by single coyotes—and since these animals of which I speak are not much smaller than the old timber wolf, it does not seem at all impossible.

Unless the price of fur goes up to a point where it will pay to trap these coyotes, or until a bounty is placed on them by the county, it will be but a very few years before they do some real damage to the deer. Of course one wonders why they have not reached such numbers in the past as to have exterminated all of the deer, but I think that civilization is concentrating the deer and the coyotes into such a small tract of land in the hills that the coyote is gaining advantages every year—especially during the hard winters. This same question is asked about the tree bettles—why they haven't destroyed all the timber before, since they were left alone for years—while I know there is a real reason I don't know what it is.

As for deer—our first few months in there we saw great numbers of does, and with every doe there was at least one fawn and sometimes two. Wagner told me that there were a great many barren does, but all the barren does I saw had their fawns close by. And that reminds me of another peculiar thing. There was a cave on the Logan side of the river where I thought there might be a bear or so, and while I was sitting there one day waiting for the dog to come up, so I could send him in, I saw an old doe and two fawns come down to drink on the other side of this river. It was the twenty-sixth of November and the deer had just started running, the first signs of this being on the twenty-fifth. This old doe led both fawns down and they started to drink. As soon as she saw they were busy at it she started up the hill on a dead run, but they heard her and caught her before she had gone 200 yards. She walked calmly back to the river with them again and started them to drinking again. This time she made her get away, although the poor little devils ran and bleated around there for half an hour, until they finally laid down under a big oak and tried to forget it. I do not know that this is the way the doe gets away from her fawns at this time of the year, but this I did see; and I also know that after the season of mating is over she comes back to her fawns again. During November and part of December these little devils were all alone, but at the time we left the hills—February 27—every doe had her fawns with her and seemed as loving to them as ever. The whole trip was the most interesting I was ever on, and I really believe I learned more about nature in those five months than during my entire life.

I had an interesting experience with a skunk. It has been my belief that I was a regular skunk trapper and on this particular day I found a large one in a trap on a sloping hill. The idea is that if you get their hind feet off the ground (their rear muscles being the ones that work the scent bag) you can kill them without smelling up the fur. I, therefore, lifted this fellow off the ground with a pole and hung him by one of the springs of the trap in a manzanita bush. I then walked up very close to him so as to be able to

shoot him through the brain. As I did so he reached one leg behind him, got a purchase on one of the limbs of the bush and shot me square in the eye and ear, at the same time dropping down out of the bush, where he proceeded to work on me from the ground up. As soon as I had sufficiently recovered to open one eye, I took a squint at him and he was sitting there calmly chewing on the fish head with which I had baited the trap. This calmness of theirs impresses me more than anything else that they do, except, of course, the thing I have just mentioned. When you come on them in a trap they will invariably look up at you for an instant and then go on eating, or picking their teeth, or whatever it may be that they are interested in.

After the twentieth of November the large bucks started to come down from the high country, though the spikes and forked horns had been running wild a week previous to this. After that the ground was torn up in huge chunks on every hillside and opening, in the entire forest. It was not my luck to see any real fights, though I heard one time a clashing of horns in the brush within thirty feet of the trail that must have meant trouble. Also, two of the last coyotes that I trapped had large unhealed gashes in their heads and along their sides that could have been made by horns only.—ROY H. BLOOD, *Madera, California.*

AN OPOSSUM SEEN IN PACHECO PASS.

Last summer I was driving from Fresno to Monterey via Pacheco Pass, when about fifteen miles out from Hollister and east of that place I saw something which at the time I believed to be a cat. Although dark, I had a strong spot light and by using it I could see the shining eyes of the animal. I brought the car to a sudden stop and ran up to where it was lying, whereupon, it started to walk off. I grabbed a small stick and hit it lightly. It lay as if dead—it not only was playing possum, but it was a possum! It had the long slick tail which is similar to the tail of a rat. The hair was gray and white tipped and the face was the bald face of the opossum (*Didelphis virginiana*). I picked it up and held it for a few seconds, but it began to squirm and when I dropped it it ran into the shrubs at the side of the road and was gone.—R. D. LIBBY, *Fresno, California.*

THE OPOSSUM IN VENTURA COUNTY

Being a southerner and having had, last November, a fine opossum (*Didelphis virginiana*) killed by a friend, and baked with sweet potatoes in the true southern style by an old negro from Dixie, I was particularly interested in the item published in the January number of CALIFORNIA FISH AND GAME.

The opossum, a male, was killed in Ventura County, about two miles up the Santa Clara River from the mouth and was the first one ever heard of in this vicinity. It was larger than any I ever saw in the south—California must agree with them.

Since this opossum was killed, I have heard of two being caught near the line of Ventura and Los Angeles counties, but these were only reports. I did not see the animals myself.—GEO. P. AUSTIN. *Oxnard, California.*

CONSERVATION IN OTHER STATES.

MUSKRAT SEASON CLOSED IN MINNESOTA.

In October, 1920, the department sent out thousands of questionnaires asking for information and an expression of opinion from trappers, fur buyers and dealers, farmers and sportsmen as to what steps should be taken to preserve a breeding nucleus of muskrats.

Fully 90 per cent of the answers favored an immediate closed season. The commissioner petitioned Governor Burnquist for additional protection which was duly granted and order No. 2 was issued protecting muskrats until the close of the 1921 regular session of the Minnesota legislature.

It developed later that muskrats were still numerous in some localities and complaints of the damage to highways and grades poured in so rapidly that the department could not possibly investigate them all. Whereupon another petition was prepared asking for a lifting of the ban in thirteen counties. This was acted upon favorably by Governor Preus and order No. 3 was issued.—*Fins, Feathers and Fur*, December, 1920.

SPORTSMEN'S CLUBS IN NEW YORK

"There are today in New York some 475 sportsmen's clubs comprising a membership of about 40,000 hunters, fishermen, and other conservationists. Even this total, however, is smaller than it should be, in view of the fact that last year some 300,000 persons purchased hunting and trapping licenses in New York—to say nothing of the fishermen of whom no license is required."—*The Conservationist*, April, 1921.

INTEREST IN FISH AND GAME CONSERVATION IN UTAH.

Interest in fish and game conservation in Utah has been greatly stimulated through the efforts of the United States Forest Service, which has organized local fish and game protective associations and unified them into a state organization. Since October, 1920, more than twenty-five locals have been established.

ANNUAL DIVIDEND FROM FUR-BEARING ANIMALS OF NEW YORK STATE.

The game and fur-bearing animals of New York state, if capitalized, are worth not less than $53,000,000; they return an annual dividend of more than $3,200,000; and they cost the state for their protection and increase the nominal sum of $182,000. This cost of protection and increase is thus less than 6 per cent of the annual dividend.

REPORTS.

VIOLATIONS OF FISH AND GAME LAWS.

January 1, 1921, to March 31, 1921.

Offense	Number of arrests	Fines imposed
GAME		
Hunting without license	20	$200 00
Trapping without license	4	40 00
Deer—closed season—killing or possession	23	875 00
Does—spike bucks, fawns—killing or possession	4	475 00
Bear—closed season—killing or possession	1	10 00
Brush rabbits, squirrels—closed season—killing or possession	6	100 00
Quail—offering for sale—excess limit—killing or possession	10	350 00
Doves—closed season—killing or possession	1	25 00
Ducks—excess limit—closed season—killing or possession	12	250 00
Protected shore birds—killing or possession	8	225 00
Non-game birds—killing or possession	17	755 00
Night hunting	12	50 00
Shooting ducks from power boat	1	25 00
Mudhens—killing or possession closed season	1	25 00
Total game violations	120	$3,405 00
FISH		
Angling without license	10	$190 00
Clams—undersized—excess limit—taking or possession	12	310 00
Crabs—undersized—excess limit—taking or possession	16	360 00
Abalones—undersized—closed season—taking or possesion	19	627 50
Lobsters—undersized—taking or possession	1	25 00
Striped bass—underweight—taking or possession	9	155 00
Young fish—taking or possession	2	20 00
Barracuda—underweight—taking or possession	1	25 00
Sturgeon—closed season—taking or possession	1	20 00
Sunfish, crappie—closed season—taking or possession	5	40 00
Trout—excess limit—closed season—taking or possession	7	190 00
Illegal nets in restricted districts	18	595 00
Total fish violations	101	$2,557 50
Grand total fish and game violations	221	$5,962 50

SEIZURES—FISH AND GAME AND ILLEGALLY USED FISHING APPARATUS

January 1, 1921, to March 31, 1921.

GAME.

Deer meat	376 lbs.
Quail	148
Ducks	857
Doves, pigeons	1
Rabbits, squirrels	12
Miscellaneous birds	30
Beaver skin	1
Pine marten skins	5

FISH.

Striped bass	926 lbs.
Barracuda	3625 lbs.
Halibut	5669 lbs.
Sunfish	21
Trout	22
Crabs	2516
Abalones	317
Abalones	6497 lbs.
Clams, pismo	600
Clams, cockle	992 lbs.
Lobsters	1930
Lobsters	100 lbs.
Illegal nets	16

SEARCHES.

Illegal fish and game	16

STATEMENT OF EXPENDITURES.

Period from July 1, 1920, to March 31, 1921.

Administration:		
Commissioners	$310 68	
Executive offices	19,169 10	
Printing	4,985 82	
Research and publicity	4,789 95	
Accident and death claims	1,427 61	
		$30,683 22
Commercial fish culture and conservation:		
Superintendence	$11,814 75	
Inspection and patrol	23,754 51	
Research	22,948 71	
Statistics	7,989 15	
Market fishing license commissions	375 50	
Propagation and distribution of salmon	19,789 93	
		86,622 55
Sporting fish culture and conservation:		
Superintendence	$11,203 55	
Printing	198 54	
Prosecutions and allowances	391 85	
Angling license commissions	12,627 40	
Fish exhibits	4,323 19	
General patrol (pro rata share)—		
San Francisco District (40 per cent)	38,943 71	
Los Angeles District (40 per cent)	12,506 31	
Sacramento District (40 per cent)	21,413 88	
Propagation and distribution of trout	109,069 47	
		200,677 90
Game conservation:		
Printing	$267 18	
Prosecutions and allowances	970 73	
Hunting license commissions	19,134 70	
Mountain lion hunting (and bounties)	6,724 76	
General patrol (pro rata share)—		
San Francisco District (60 per cent)	43,283 45	
Los Angeles District (60 per cent)	16,533 10	
Sacramento District (60 per cent)	32,123 74	
		121,173 59
Tahoe camping ground		402 11
		$439,559 37

CALIFORNIA FRESH FISHERY PRODUCTS FOR MONTHS OF JANUARY, FEBRUARY AND MARCH, 1921.

Compiled by Fish and Game Commission, Department of Commercial Fisheries.

Species of fish	Del Norte, Humboldt	Mendocino, Sonoma, Lake	Marin	Solano, Yolo	Sacramento, San Joaquin	Colusa, Butte, Tehama, Glenn	Contra Costa, Alameda	San Francisco, San Mateo	Santa Cruz	Monterey	San Luis Obispo, Santa Barbara, Ventura	Los Angeles	Orange	San Diego	Imperial	Total	Mexican, brought into California
acore												45				45	
hovies								1,850		5,800		2,420		48,555		58,625	
racuda											33,041	352,118		332,060		717,219	1,757,921
efish									1,523	16,772						18,295	
caccio								41,043	111,986	347,674						500,703	
dito											30	21,671	8	20,203		41,912	22,587
p				15,184	35,788		14,857	40								65,869	
fish		37,761		5,831	16,386		7,173									67,151	
lipepper								22,985	2,513	32,277						57,775	
akers												57,327				57,327	295
tus Cod	487							35,109	7,727	28,161		297	26	527		72,334	
phin																	
unders	9,629		465	1,448			3,060	18,926	9,051	910	105	885				44,459	
yfish							176	29,870		565		13,054	4,985	205,381		254,031	
enfish																	
ce								6,690	12							6,702	
ibut								1,417	472	2,064	60,425	500,138	46,761	202,063		822,340	236,258
rdhead				324	26,976		34,657									61,957	
ring	4,994		731				21,220	441,325		1,300	10					469,580	
gfish								3,952	30,128	887	32	113,696		1,145		149,840	315
kerel										1,442	2,343	704,749	9,952	72,647		791,133	29,084
lin																	
let														433		433	7,670
ch	16,129	62	24,169				14	16,709	1,610	13,998	7	21,795	82	2,066		96,641	3,898
				589	1,815		2,329									4,733	
npano									37	174	16	3,622		20		3,869	305
k Bass											74	13,913	1,964	17,565		33,516	3 095
kfish	1,416		60					125,470	61,417	254,830	21,721	512,851	11,761	261,926		1,251,452	13,610
lefish								153,995								153,995	
non	67		194	33,884	27,225	2,383	57,161	112 478	5,653	174,583						413,668	
dabs								148 623	13,528	1.313		4,437	5			167,906	
lines			98						92	1,479,625		17,230,790	822,175	1,451,914		20,954.691	
pin												8,794		4,974		13,768	312
Bass—Black												4,130		19,050		23,180	21,562
Bass—White									146	110	1,358	43,293	142	39,194		84,243	85,439
Trout												92	2,510			2,602	6,568
d				2,505	5,396		17,997	1,320	10							27,228	
d—Buck				477	824		4,419									5,720	
d—Roe				1,971	930		7,359									10,260	
pshead											29	448		9,594		10,311	

[illegible]								22,295		1,662		1,406	232			25,595	
ak																	
	8,978		5,502				4,221	51,338	221	4,830	22,629	50,129	921	13,771		102,540	607
								880,807	35,500	14,595	7,224	48,145	729	6,166		992,666	175
Bluefish				165	12,169		159										12,493
Striped Bass			272	9,457	8,622	41	130,414	13,942		15							161,763
Kingcares												203		1,555			1,758
Seabass					1,976		85										2,061
Swordfish																	
Tomcod							20	15,078									15,098
Trout—Farm																	
Trout—Steelhead																	
Tuna												101		2,209		2,310	682
Tuna—Bluefin																	
Tuna—Yellowfin												1,060				1,060	
Turbot			146													146	
Whitebait			919													919	
Whitefish												12,062		3,013		15,095	600
Yellowtail							516					117,788		76,920		195,224	100,794
Miscellaneous				49				4,633	2,358	3,018	6,617	7,086	857			24,618	200
Total fish	41,700	37,823	32,556	71,884	138,107	2,424	305,837	2,151,395	284,004	2,386,605	164,901	19,818,565	908,110	2,792,951		29,131,862	2,292,577
Crustaceans:																	
Crabs (doz.)	1,048	22	79					9,405	122	5						10,681	
Ecrevisse (doz.)																	
Shrimps								150,189				639	26			150,854	
Spiny Lobsters											13,607	34,223	937	17,727		66,494	383,279
Mollusks:																	
Abalones										235,320	16,686					252,006	8,094
Clams—Cockle	5,466		1,359								276			235		7,336	
Clams—Mixed	4,508		13,519								533	155				18,806	
Clams—Pismo									957		42,758					43,715	
Clams—Softshell	112	2,084	9,145				29,089	12,553								52,983	
Cuttlefish			40					2,217	6,333	13,316		173				22,079	
Limpets																	
Mussels							40		600	485	97	65				1,287	
Oysters—Eastern (No.)			301,181					783,670								1,084,851	
Oysters—Native																	
Snails																	
Squid										32,623		13,225		39,964		85,812	
Miscellaneous:																	
Frogs (doz.)																	
Terrapins (doz.)																	
Turtles													61			61	145
Scallops											636					636	

All amounts shown in pounds unless otherwise specified.

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CALIFORNIA FISH AND GAME

"CONSERVATION OF WILD LIFE THROUGH EDUCATION"

Volume 7 SACRAMENTO, OCTOBER, 1921 Number 4

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FIG. 54. Sardine boats waiting to unload, San Pedro. Photograph by E. M. Nielen.

THE SARDINE OF CALIFORNIA.*

By Will F. Thompson.

In this number of California Fish and Game appear a series of articles upon the California sardine, dealing with the history of the fishery, the methods of catching, of canning, and the use of waste fish as fertilizer. They are not technical in nature, being designed for readers interested in fisheries in general, and do not attempt to speak authoritatively on debated points. The industry has been, for the past five years, an important one in California, and crucial years are ahead of it.

It should be understood, in the first place, that the sardine packed in California is a true sardine, in the sense understood by scientists of recognized standing.

This is not true of the "sardine" packed in Maine and other New England States. That is in reality a young herring, known to naturalists as *Clupea harengus*, whereas the true sardine is known as *Sardina pilchardus*. This herring is caught in great numbers along the Maine coast in weirs, or traps made in relatively shallow water. Its habits are different in many respects from those of the true sardine, for the eggs of the herring are laid on the sea bottom and attach themselves

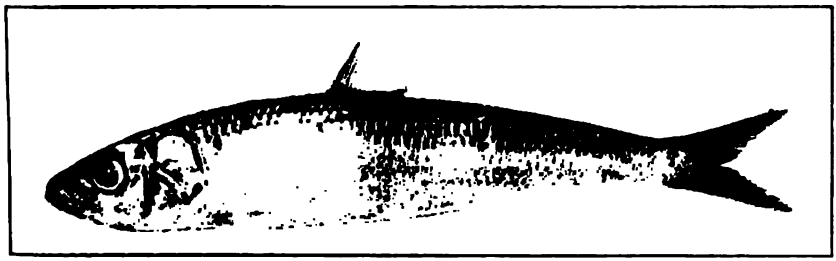


Fig. 55. The California sardine, a specimen without the usual spots. Photograph by H. B. Holmes.

there, while the eggs of the sardine are laid free in the water and drift with the currents. The differences in structure, flavor, etc., are equally marked.

The same remarks may be made about the Norwegian "sardines" save for the fact that among them one finds two species of fish widely different from the true sardine, namely the young of the herring, and the bristling, or young of the sprat, called *Clupea sprattus* by European writers. It is noteworthy that the English courts decided in 1916 that Norwegian fish packed as "sardines" could not be admitted into England under that name. According to the review of the court, bristling had been packed in oil in Norway since 1874, and they were at first called "Sproetten in oel," later "Sproetten a la Sardine," and finally "Norwegian sardines." The name sardine was therefore limited to the young of the pilchard, which are canned in France, Spain, Portugal and Italy as sardines. The pilchard itself is canned in Cornwall as pilchard. Later the Australian courts followed the example of the English.

*California State Fisheries Laboratory, No. 30.

The true sardine, or pilchard, is found from England along the Atlantic coast of Europe southward into the Mediterranean, and the adjacent coasts of Africa. It has been divided into two races, or varieties, the one found in the Atlantic and known as *Sardina pilchardus pilchardus,* the other found in the Mediterranean and known as *Sardina pilchardus sardina.* It still remains to be carefully investigated whether the difference between these two subspecies, or varieties, or races, is less than exists between some of the other "species" of sardine.

There are, indeed, throughout the world a number of these very closely related species of sardines. Thus there is the sardine of the Pacific Coast of America, from Alaska to Mexico, known as *Sardina coerulea,* and that of the coast of Peru, known as *Sardina sagax,* perhaps belonging to the same species, but more likely not. There is a gap of considerable extent between the extremes of their distributions, namely the tropical waters of the Gulf of Panama, and careful examination of many specimens will some time be necessary to determine their distinctness. Nevertheless, they both are extremely closely allied to the sardine or pilchard of Europe, in habits, distribution in the sea waters, movements and structure. This is granted by every competent authority. They are the only true sardines found in the waters of the Americas, save, perhaps, a species found occasionally in the West Indies, for no sardine is found on our Atlantic coast.

On the other side of the Pacific there are found the Japanese sardine, *Sardina melanosticta,* and the Australian *Sardina neopilchardus.* These are both very close to the European species. There is also a sardine to be found in the waters of the Cape of Good Hope, known as *Sardina ocellata.* The interrelationships of these various species are very poorly known and the morphological characters upon which they are based are insufficiently studied.

However, it is very plain that they are entitled to the name sardine, or pilchard, in contradistinction to the young of the herring, or sprat.

Regarding their habits and rate of growth, not a great deal is known. It is known that the eggs are pelagic, that is, laid so that they float freely in the open ocean waters, and that the adults in the waters of Europe and America disappear before spawning. Whether they are subject to the great fluctuations in abundance to which the herring is, still remains to be seen. The California Fish and Game Commission has collected careful data which it is hoped will in due time throw light on the subject of habits, rate of growth, migrations, and the presence of great changes in abundance. If the results which have been obtained in work on the herring can be paralleled, they will undoubtedly prove of much importance.

The following articles are regarded in no sense as a part of this work, although they do, to a certain extent provide a basis for judgment as to the changes which may occur in methods of fishing and canning in the future. This is especially true of the article on fishing gear and methods. An article by Professor Starks of Stanford University has appeared, in the April, 1918, number of CALIFORNIA FISH AND GAME upon the scientific characters of the members of the sardine and herring family found in the waters of California, and anyone interested is referred to that publication.

HISTORICAL REVIEW OF CALIFORNIA SARDINE INDUSTRY.*

By WILL F. THOMPSON.

The sardine industry in California is, as it now exists, essentially a product of the great war. Previous to its outbreak there had been a relatively small pack at Monterey and San Pedro, but the machinery for a vast expansion already existed in part in the tuna canneries of southern California. With the practical cessation of sardine imports into the United States in 1915, and the later great foreign demand, the pack of California sardines rose to great heights. Now with the coming of peace and the gradual return to normal conditions still so far removed, it remains to be seen how our new industry will meet competition. The development of fishing and packing methods have thus far been incidents only in the thorough upheaval of 1914, and the history to be here recorded gives little clue to how well fitted they are for survival. So, in a measure, this review is not a history, because it is written during the event.

Nevertheless, since the existence of methods, and a knowledge of the availability of the raw material, enabled the California sardine canners to so readily seize their great opportunity, the prewar period is of much interest. Failures and crudities naturally played their parts, as might have been expected, for a bodily transportation of fishing and canning methods from the great existing European and Maine fisheries was impossible. The California sardine is a true sardine, with vastly different habits than the young herring and sprat of the Maine and Norwegian fisheries. Where in Maine weirs may be employed, here nets must be used. And of course, the quality of the fish is also different, requiring different treatment. At the same time, the difference between French and American labor and physical conditions effectively precluded the introduction of French methods of canning save in a general way. It is highly to be regretted that even at the time of the outbreak of the war, cannery methods were still imperfect and that such packs as that of the round can had still to be tried.

THE PREWAR PERIOD.

The canneries.

The Golden Gate Packing Company of San Francisco was the first sardine cannery on the Pacific Coast. During 1890, 1891 and 1892 it put up 20,000 cases of sardines in quarter-pound cans of the usual type, 7000 cases of one-pound round cans, and 7000 of two-pound. But, so it was said, the appearance of the sardines was erratic, and this, combined with other causes, resulted in the sale of the machinery, and its shipment to San Pedro, where sardines were to be found more consistently.

There it was utilized by the Southern California Fish Company, managed by A. P. Halfhill. This concern continued to pack sardines in a limited way until 1909, but in the meantime, in 1906, it had begun packing tuna, and toward this its energies were principally directed

*California State Fisheries Laboratory, No. 31.

until 1916. Other canneries, such as the Lower California Fisheries Company, the Pacific Tuna Canning Company, and the Premier Packing Company, all of San Diego; the Halfhill Tuna Packing Company, the South Coast Canning Company, and the Los Angeles Tuna Canning Company, of Long Beach; and the Van Camp Sea Food Company and the White Star Tuna Packing Company of San Pedro, began operations on the tuna. So that in 1916 there were ten firms engaged in packing this fish in southern California, with a long winter season when no tuna were available while sardines were. These firms provided the first great pack of sardines.

In northern California no such parallel industry had prepared the way. But F. E. Booth had, in 1903, started a cannery at Monterey, and in 1906, the Monterey Fishing and Packing Company (later reorganized as the Pacific Fish Company) had established itself. Mr. Booth began in a small experimental way about 1902 in a shed on a back street in the town of Monterey. His real canning operations were begun in 1903 in a small building on the waterfront where his cannery now stands. He started with quarter-oils and a little later packed larger fish, calling them mackerel, to suit the market then existing. However, seven or eight years later, the federal government ruled that they would have to be labelled sardines. The early canning was done by the old method of hand flaking, drying in the sun, and hand soldering the cans. For the first three years there was not even a power winch for hoisting the fish from the boats to the cannery wharf. Fish were hoisted by hand, pulled up in baskets and carried in the same to the tank in the cannery. The pound oval pack which has become the specialty of the Monterey canneries was developed under these normal conditions, and was well established at the outbreak of the war. So here, although but two canneries awaited the great expansion of the industry, they were on a relatively firmer basis, in so far as the sardine was concerned. In 1916, not only were the two existing firms kept busy, but a number of new canneries were started.

The fishing methods.

But, in northern California there had also developed a successful method of fishing, which provided a more uniform and cheaper supply of fish. This successful method was the use of the lampara.*

There has been some controversy as to whether or not fishing before 1905 was done with a gill net, and whether this was carried on during the daylight or at night. Gill netting, at present, is done in a small way for bait and for the fresh fish market, and has been practiced thus for many years at Monterey. So it is possible that during the first year of experimenting the fish were supplied by the gill net fishermen.

However, from 1903 to 1905 a purse net was used for sardines, for the most part in the daytime, usually in the afternoon, but occasionally at night. The fish were located by seeing them jump at the surface or by seeing schools in the shallow water. The cannery (F. E. Booth) furnished the equipment and the fishermen worked by the month for wages.

*These notes regarding the lampara are those of Mr. W. L. Scofield, who kindly made inquiries regarding the matter at the writer's request.

Instead of the modern lighter the "Sacramento River seine boat" was used. It was a light, double-ended boat, carrying the net and the catch. The seine was circled by hand from the skiffs, pursed from the seine boat or the skiffs, and pulled up between the fishing launch and the seine boat. The catch was dipped out and into the seine boat, about as at present.

The net was made of one-inch mesh, from No. 6 cord, was twelve fathoms deep and two hundred long. There being no "bag," the fish were held by pursing the bottom by means of a rope run through rings. The net was extremely heavy because of the small mesh, and ten men were necessary. Hauls had to be made in shallow water, because the fish were almost sure to be frightened and to sink below the net if the water were deep enough. Fortunately the sardines could be found in shallow water a good part of the year.

As the capacity of the cannery was only about ten tons, but one crew of ten to twelve men under a captain was employed during the first three or four years. The fishermen often failed to obtain a supply, and in 1905, the captain, Pete Ferrante, with Booth's backing, sent to Tangier for a lampara net, essentially similar to the one described elsewhere in this volume. This net had a bag of fine mesh in which the fish were trapped before they could sink, and it was easier to haul because of the coarse mesh in the wings. The purse seine and the lampara were at first used together, one for the day, the other for the night fishing, but in 1906 the purse net was abandoned because more expensive. Other lamparas were patterned after this first one, which soon went to pieces, and of course many modifications have been made since. But the use of the lampara soon enabled the fishermen to catch sardines in deep water and at night, when they could be located by their phosphorescence. The result was a larger and more certain supply. It can not be doubted that the lampara has played a most important part in the establishment of the sardine industry on this coast.

In 1905 or 1906, the lampara was carried on the launch, and a barge substituted for the seine boat. Since then larger and larger launches have been used, with more powerful engines, just as in all other marine fisheries the methods of transportation have been steadily improved. The nets themselves have been deepened to fish more efficiently, and in southern California the type of net which the Japanese fishermen have modified from the lampara is thought by many to be a great advance.

THE WAR PERIOD.

Then, with two canneries packing sardines at Monterey, the tuna canneries awaiting a method of filling in the long winter season in southern California, and the methods of fishing already developed, there occurred the outbreak of the Great War in 1914. It altered the sardine industry on this coast as thoroughly and profoundly as it did any other industry. First, in 1915, the domestic market was abandoned by the foreign packers to our own Maine and California industry, imports dropping sharply and continuously. Then, in 1917 and 1918, the European markets themselves were opened to our products by the derangements of supply, etc., in Europe, while with our entry into the war came the insistent campaign for food conservation, including the

eating of fish rather than meat. The effect of foreign conditions upon our imports of "fish packed in oil" and our exports of "canned fish except salmon" is shown in Figure 56, taken from the reports of the Department of Commerce of the United States. This illustrates this point well, since sardines form the bulk of both categories. It will be noted that imports declined in 1915, but that exports did not rise until later.

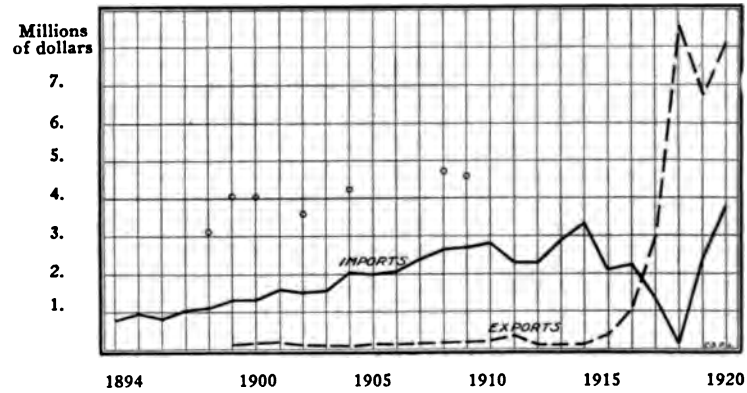


FIG. 56. United States imports and exports, to show condition of foreign trade. Imports of "fish (except shell-fish) packed in oil," and exports of "canned fish except salmon," as given by Monthly Summaries of Foreign Commerce of the United States, issued by Bureau of Commerce. Total value of Maine pack of sardines for various pre-war years shown as circles.

Foreign conditions.

To understand this change, however, the condition of affairs in Europe must be analyzed, and we may briefly review the history of the fisheries at Stavanger, Norway, where the packing of the Norwegian "sardine" is extensively done. In the lower part of Figure 57 are shown the exports to the United States. It is obvious that the fall is entirely parallel to that shown by Figure 56 for the imports into the United States, and that it was a fall of identical character in quantity as well as in value. However, in Figure 57, the middle section shows that the total quantity packed did not fall until a year or perhaps two years later, and that the value of the packed fish did not fall until three years later, namely, in 1917. In other words, the market for Norwegian sardines was found in Europe during the first years of the war, just as trade reports also indicate that better prices were obtainable in the British and German markets than in the United States. This condition prevailed during 1915, and also to an even more marked degree during 1916, a year termed by the Norwegians the "golden year" because of the high prices, and despite the rise in cost of materials and labor. But in 1917 and 1918 the exports to the United States and the total production both fell, because of scarcity of materials such as tin plate, olive oil, fuel oil, the prevalence of labor troubles, influenza and the placing of embargoes by belligerent countries. In 1917, for instance, there was a marked shortage of tin plate, save where the factories supplying goods to Germany were provided with cans by that

country. These conditions continued and were intensified during 1918, so that, in contrast to 1916, it was termed a "dead" year.

The effect of such changes as they affected the Norwegian canneries is, in passing, of great interest to us, as perhaps such changes as occurred to them may be apparent in the case of our own industry. The first result of the increase in price obtained was the founding of more canneries in 1916, and the later closure of many. Then there was

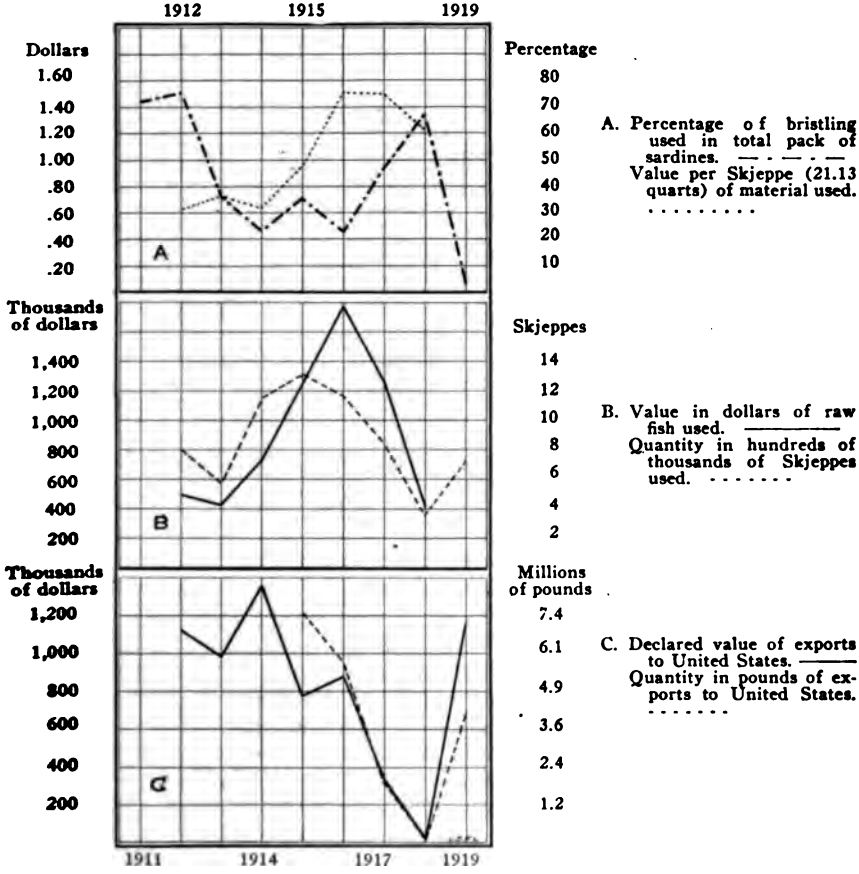


FIG. 57. Condition of sardine fishery at Stavanger, Norway. Data from Supplement to Commerce Reports, Bureau of Foreign and Domestic Commerce.

the increased value per unit quantity of fish used, apparently not dependent upon the composition of the catch. Thus in the upper section of Figure 57, the percentage—among the total of herring and sprat—of bristling, or young sprat, which are supposed to provide the best pack of "sardines," is shown by the line of dots and dashes. It is obvious therefrom that the largest part of the war pack was made from the young herring and the blending, or mixture of sprats and herrings, and that not until the very small pack of 1918 did the percentage of bristling rise. And that very promptly fell upon the

resumption of packing and export to the United States in 1919. But the value of raw fish per "skjeppe"* rose and fell in accordance with the value of the total. In other words, the war market was flooded with the pack of herrings and blanding, while the number of canneries first increased and then diminished.

That some such conditions applied throughout Europe would seem to be true from the fluctuations which occurred in the importations from various countries into the United States. These are shown in Figure 58. With the exception of the imports from Italy, all countries

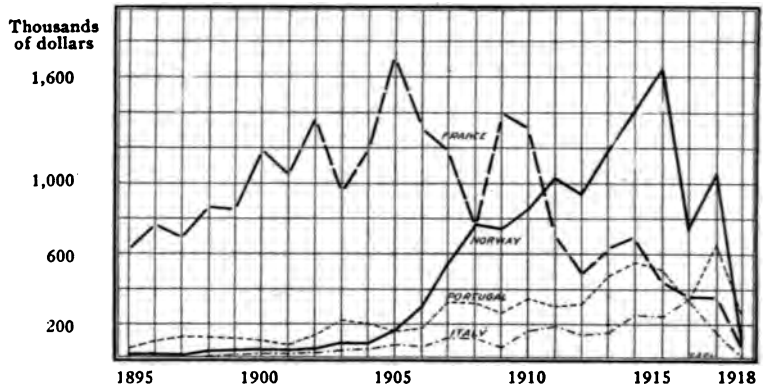


FIG. 58. Imports into the United States of "fish (except shell-fish) packed in oil," from various countries, showing rise of Norwegian and fall of French imports during pre-war period, also fall of all imports during war. Data from Bureau of Foreign Commerce and Navigation of the United States.

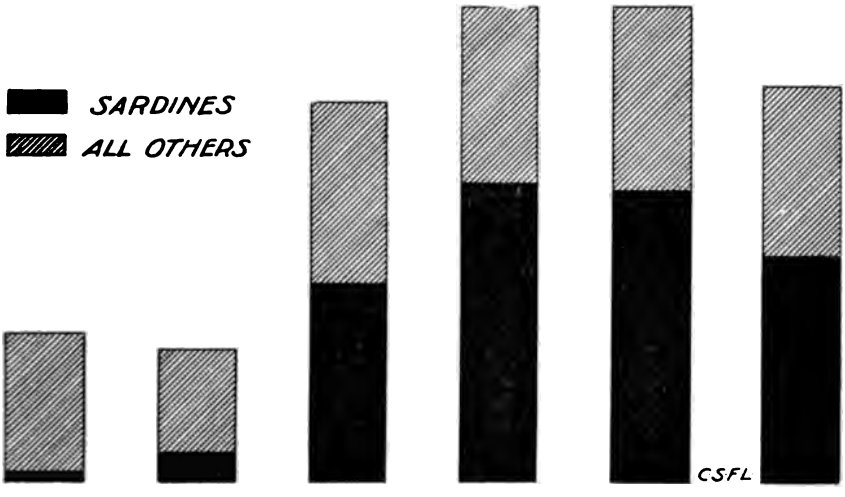
showed a decreased total in 1916, and a near collapse in 1918. Our consular reports show much the same to have occurred in Portugal as in Norway, namely, a first diversion of produce to European markets, then a general slackening of the industry, producing, in so far as imports into the United States were concerned, a nearly continuous fall. We may therefore summarize the causes of the fall in imports and the rise in exports as due to, first, the abandonment of the American market by European packers, and then the collapse of the European industry in part at least. American packers therefore were first offered a better domestic market and then a share in the European market in addition.

The rise of the California industry.

It will be seen that the most favorable conditions existed for our sardine fisheries, and the resultant effect upon the extent of our pack may be seen in Figure 59. Almost all sardines which are taken in this country are packed, and the increase in pack is clearly shown. The first great pack was, it is obvious, in 1917. And this corresponds with the great rise in value of sardines in this country, resultant in part from the conditions we have dealt with above, and in part from war conditions considered more generally in their effect on the domestic markets. At the same time we must remember the great encouragement

*A skjeppe equals 21.13 quarts.

given to the use of fish during 1917 and 1918 after our entry into the war. In Figure 60, we have shown the rise in value of Maine, Norwegian, Portuguese and French sardines in so far as they were obtainable in the Los Angeles markets, utilizing quotations on cases of a hundred quarter-pound oil sardines. When it is borne in mind that the California sardines were packed to meet the high values of 1917 and 1918, Figure 59 should be clearly understood.



	1915	1916	1917	1918	1919	1920
	millions	millions	millions	millions	millions	millions
ines	4	16	104	158	154	119
ish	78	70	200	250	250	208

c. 59. Catch of sardines in millions of pounds, compared with catch of all fish in California during period. Data from reports of California Fish and Game Commission, save for 1915, which is from rts of the Federal Bureau of Fisheries.

The rise in value is shown in Figure 60 on a logarithmic scale, which has the effect of making the rise of each commodity show as it would if reduced to a percentage basis, and the slope of the lines is therefore comparable and truly indicative of the relative rise in value. An increase of a dollar a case of Maine sardines would plainly be a larger proportionate rise than a dollar a case of French sardines, yet the ordinary charts would show the two increases as identical amounts, but the logarithmic chart shows them as considered in relation to the first price, namely, a greater rise for the Maine than for the French in proportion. The figure demonstrates that the Norwegian sardine did not rise as fast as the Portuguese, save for a brief period in 1920, and that the Maine sardine fluctuated in price much as did the Norwegian. In so far as the French sardine is concerned, the sudden rise in price in 1914 and the subsequent practical disappearance we have not been able to analyze. We have no data on the California pack of quarter oil sardines which is comparable to these shown, because such a pack was not placed on the market until 1917. But there are shown the changes in value of Booth's Crescent one-pound oval pack, from

Monterey, and this shows much less relative rise than the others utilized below.

Just as the first flush of war prosperity and high prices in Norway in 1915 and 1916 resulted in the starting of eighteen new canneries, so in California the tuna canneries turned suddenly to sardines and

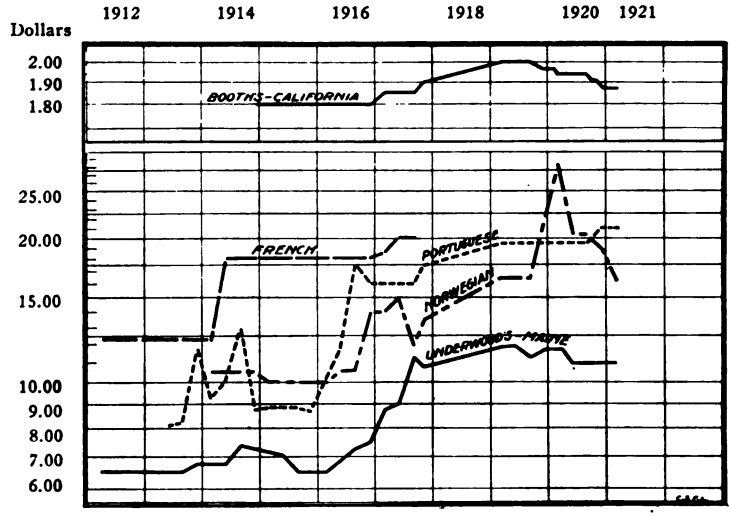


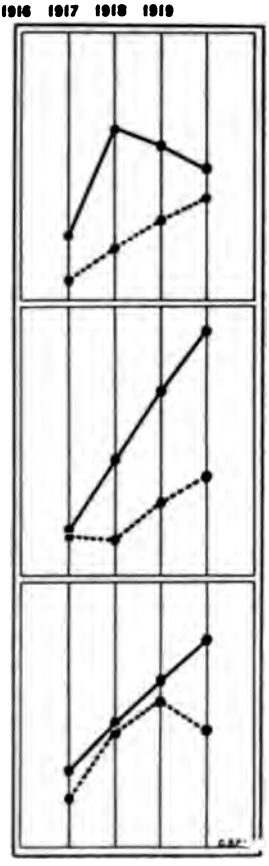
FIG. 60. Fluctuations in wholesale price per case of quarter-pound-oil sardines in Los Angeles during and shortly before the war. Above, price per dozen of Booth's Crescent, pound oval size. Given on logarithmic scale to show relative rather than absolute fluctuations in price. Data from Commercial Bulletin of Los Angeles.

new ones were constructed. To illustrate this point, we have attempted to tabulate the canneries and the time of their construction or diversion to sardine packing, according to the year, with the following results:

1894— 1 cannery built.
1903— 1 cannery built.
1906— 1 cannery built.
1915— 1 cannery built.
1916—14 canneries start packing, 11 previously tuna.
1917—11 canneries built.
1918—10 canneries built.
1919— 5 canneries built.
1920— 2 canneries built.

Of course, some of these are no longer existent or have ceased operations, but the point we desire to make is obvious, that there was a very considerable increase in canneries due to the value of the canneries, both for Monterey and for southern California, as contrasted with the much more modest rise in the pack produced, especially in southern California. It will be remembered that somewhat the same sequence of events occurred in Maine, when during the early days of the industry the canneries multiplied faster than the pack increased, until consolidation and elimination took place.

But there was another parallel with the Norwegian pack perhaps not less important, although perhaps not due to the same causes. And that was the emphasis upon quantity rather than quality. Previous to the outbreak of the war the pound oval held the field, but for a time the round can cooked inverted and by steam took a very prominent



ALL FISH CANNED IN CALIFORNIA BY CASES

	Northern	Southern
1916..	196,104	522,609
1917..	480,111	1,538,122
1918..	729,100	1,885,202
1919..	905,206	1,166,435

VALUE OF FISH PACKING PLANTS

	Northern	Southern
1916..	$860,590	$948,702
1917..	786,197	2,573,453
1918..	1,569,330	4,089,660
1919..	2,272,514	5,436,357

NUMBER OF EMPLOYEES IN FISH PACKING PLANTS

	Northern	Southern
1916..	1,573	2,289
1917..	3,090	3,261
1918..	3,829	4,210
1919..	3,123	5,119

FIG. 61. Comparison of number of cases canned, value of packing plants and number of employees.

place. Introduced in 1916 by the Van Camp Sea Food Company, and widely adopted, this round can pack proved economical, and large amounts were shipped to Europe. But due to the emphasis upon quantity production its reputation was entirely lost. Other packs were subject to the same criticism, and far-sighted canners and brokers began to insist upon quality, foreseeing the failure of their markets under the more normal conditions sure to return in time. The National Canners' Association was asked to establish an inspection service and in 1917

this was done, as is related in another part of this issue. Under the stress of our entry into the war, the government for a time put the whole force of its influence back of this inspection service, in addition to a campaign of price fixing. At present the majority of southern California packers belong to it.

By-products.

An interesting part of the war demand was the high prices paid for oil, for fertilizer and for fish meal. Many of the canneries installed plants of their own for handling their offal, producing therefrom oil, and fish meal. But ultimately so much whole fish was diverted to these plants when the profit was greatest that the matter became serious and attracted attention. The California legislature therefore passed a law in 1919 placing the control of the matter in the hands of the Fish and Game Commission. The effect was to decidedly reduce the percentage of fish diverted to this use, but in 1920 the market for such by-products had in part declined so that there was less temptation to utilize fish for that purpose specially.

Competition within the state.

The three canning districts of Monterey, San Pedro and San Diego have to a certain extent competed with each other in the past, and the history of this is interesting, although only brief analysis of this can be made. There existed, previous to the war demand, two successful sardine canneries at Monterey, packing the larger sized sardines so readily obtained there. But the single sardine cannery in the south after intermittent operations finally turned exclusively to tuna packing.

The seemingly superior vitality and success during the prewar period of the Monterey packers may have been due in part to the greater ease of fishing in Monterey Bay, with the resultant cheapness yet excellent condition of the supply of raw fish, and the use of a larger, more economical type of pack than the quarter-pound square cans of the imported brands. It is said that the larger type of pack finds its principal market in such countries as Cuba and the Philippines, as well as the United States. How far foreign sardines are able to compete for this market we have not ascertained. But it may well be that an essential element in the history of the southern and northern packers has been the greater reliance of the former upon goods fitted for export and for competition with foreign brands.

The following table illustrates the differing styles of pack made in northern and southern California, due to the larger fish which prevail at Monterey. It is said that occasionally there is a year when sizes of fish suitable for quarter-oil packs are present at Monterey in numbers sufficient to render them easily caught, but that does not seem to be often enough to establish a quarter-oil pack there:

Sardine Pack in Three Statistical Districts, According to Percentage Packed in Various Sized Cans.

District	Quarter pound, per cent	Half pound, per cent	One pound, per cent
San Diego	55.5	17.9	26.6
San Pedro	16.7	37.8	45.6
Monterey	.8	2.8	96.3

It will be seen from this table that the Monterey district has packed more of the pound sizes, while the San Diego packers have depended very largely on the small sized fish for quarter-pound cans. Whether this will explain the greater steadiness of the price, as shown for Booth's sardines (Monterey) in Figure 60, and of the quantity packed as shown in Figure 62, we do not venture to express a decided opinion.

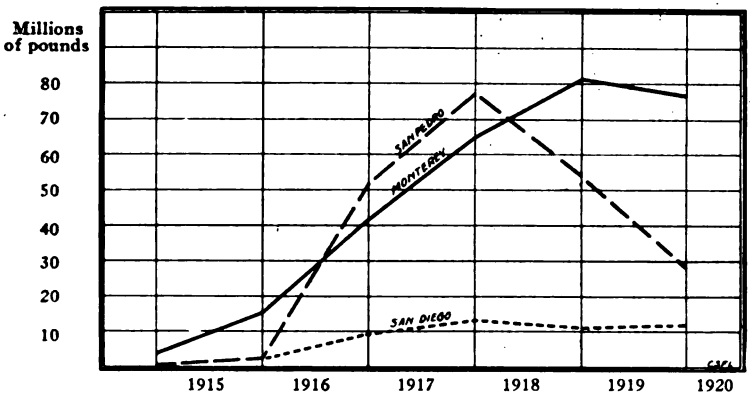


FIG. 62. Catch of sardines in three statistical districts of California. Data from California Fish and Game Commission, save for 1915, which is from Federal Bureau of Fisheries. (Note that pack of San Diego sardines is largely the valuable smaller sizes, and of Monterey of larger sizes.)

(Figure 62 shows the relative amounts packed in the three principal sardine districts of California.) This characteristic of the Monterey pack was shown also in 1915. At all events it would seem that the problem of maintaining the sardine industry in competition with foreign and Maine sardines more largely concerns the southern packers than the northern.*

It will be seen that we have not considered in detail the effect of the Maine sardine pack, as we have not yet material which bears upon the matter. But that the competition from Maine may be serious is easily ascertained from the figures for past production, in so far as we have them. In Figure 56, we have shown the pack value of Maine sardines as isolated circles for those years for which data are available.

Nor have we dealt with the appearance of the sardine, or rather the adult called a pilchard, in British Columbia. The salmon canneries there packed in 1917 a total of $11,810 worth, in 1918, $413,853, and in 1919, $371,871. These were sold as pilchards, according to the

*NOTE.—In so far as foreign competition is concerned, southern canners have recently expressed considerable concern over the effect of the rate of exchange upon the selling price of Norwegian sardines in this country.

As has been said by an official of a San Pedro corporation, with all foreign exchange at a low level, the tariff on canned fish no longer gives any protection, and Norwegian sardines are being sold to jobbers at $9.75 a case. Pacific Coast canners are compelled to ask $12 a case to pack. The Norwegian canner gets in his own money what is under normal conditions the equivalent of $20.20 for this $9.75.

This is, of course an aftermath which might have been expected from the changes in the rate of exchange, and the low level maintained by the disturbed conditions of Europe. It is one of those evidences of the desirability of restoring conditions in central Europe which are coming to light in increasing numbers.

English style of terminology. It yet remains to be seen whether the run was sporadic or not.

And, finally, we may add that it has not been our intention to in any way indicate an opinion of the future, for there is little of positive value in prophesying. Yet one may surmise that the increase of population in this country would of itself greatly enlarge the markets. From 1900 to 1910 the inhabitants of the United States increased about 21 per cent, while from 1910 to 1920 the increase was about 14 per cent. Yet the consumption of sardines, including the "fish packed in oil" and imported, increased over 40 per cent from 1900 to 1910, taking value as a criterion. The emphasis during the war upon the eating of fish could not help but have benefited the sardine industries. And added to these favorable facts, one may bear in mind the depletion in part of the salmon fisheries, and the general high cost of other foods. Indeed, despite the distinct evidence that war conditions had much to do with the birth of our sardine industry an optimist might find much to comfort him.

FERTILIZER, STOCKFOOD AND OIL FROM SARDINE OFFAL.*

By W. L. Scofield.

Introductory.

Although the fishing industry in California is new and by no means fully developed it is duplicating the experience of older industries and is giving more attention to the development of by-products. Of the hundreds of tons of fish caught in California each year, less than three quarters can be used for human food because over 25 per cent of the weight of fish is inedible. In our leading fishery industry, the canning of sardines, about 50 per cent of the catch goes into cans and roughly 50 per cent of the original weight is discarded as heads, entrails and broken and under sized fish. In mild curing king salmon, about one third of the original weight is lost in head, intestines, and backbone. In the past this great quantity of inedible fish material was thrown away as a complete loss. First in Europe and later in America this discarded material was found to be valuable and its conversion into a usable form proved to be financially profitable. A California sardine packer states that the profit derived from utilizing his sardine offal is sufficient to pay the running expenses of his cannery so that the return from the canning plant is "velvet." Although this case may be exceptional it indicates that the by-products of the industry have already assumed great importance and there is every indication that more and more fish waste will be utilized. There are at present several firms in California that make the utilization of waste fish their only business. A much larger number of reduction plants are operated in connection with fish canneries so that at present California stands well toward the top in the utilization of fish waste. The inedible or waste portion of the fish is now being converted into forms that indirectly serve as human food. Waste fish is reduced to fish meal which serves as food for animals and plants that are used as food by man. In other words we are now eating, directly or indirectly, nearer 100 per cent of the sardine than the former 50 per cent. The discrepancy in this 100 per cent consumption as human food lies in the fact that fish oil, a by-product of fish meal, is used for commercial purposes other than food. The edible oil refined from fish oil has as yet proven unsatisfactory although there is constant experimenting at present and a palatable salad oil may result.

Uses of fish meal and oil.

Fish waste was first dried and ground into fish meal to be used as a fertilizer for plants and its value as fertilizer has long been recognized. There was in the past a prejudice against using the meal for stock food because the oil in the meal was said to impart a fishy flavor to the flesh of the animal eating the meal. This has been overcome by extracting the oil from the meal before feeding it to stock. In fact the oil has been found to be so valuable that the cost of extracting it is unimportant compared with its sale value. Fish meal, by experiment and tests on a large commercial scale, has been found to be

*California State Fisheries Laboratory, No. 32.

exceedingly valuable as a stock food, equaling and exceeding tankage and grains as an animal food. Fish meal is now in demand as a food for swine and cattle but the largest demand is as a chicken food. Chicken raisers claim that fish meal has been found to be far superior to any other meaty food, as meat scraps or blood. Its value lies in its high percentage of protein, or more properly speaking, in its high nitrogen content in the form of ammonia and in phosphoric acid as bone phosphate. These are also the elements so much valued in fertilizers and fish meal now competes with the high grade nitrogen materials (as ammonium sulphate) and the cheap bone phosphates in commercial fertilizers. The chief demand in this state for the meal as a fertilizer comes from the fruit growers, especially the orange growers. The meal therefore has two chief uses, as stock food and as fertilizer. So far, the high price of the meal has largely confined its use to the more intensive growing of oranges and chickens and most of the sales are made to orchardists of southern California and to the Petaluma chicken raisers. Meal sold in the open market brings about the same price when sold either for fertilizer or for chicken food.

Sardine oil (as well as other fish oils) is used extensively in the leather tanning industry but the chief use of the clear oil is in the making of paint and the heavier fatty materials are used in the manufacture of soap.

Reduction process in general.

Fish contain a high percentage of oily fat, varying from 5 to 20 per cent in fresh sardines. This oil is not only valuable for other uses but it is a detriment in a stock food or fertilizer. The oil and fat are therefore extracted before the fish material is marketed as a fish meal. There are two general methods of removing oils from either vegetable or animal material. When the oil is to be used for human food it is usually pressed out. Oil to be used for commercial purposes other than as human food, is frequently removed by the use of a volatile solvent which takes up the oil. The solvent may then be volatilized and the oil recovered. The first fish reduction plants used the pressing method and this principle is still the one commonly used in the fish reduction plants of California. At present there are in the state but two plants using the volatile solvent method of extracting fish oil. This method will be described later. The usual practice (press method) is to cook the fish material sufficiently to loosen the flesh from the bones and break up the fish skeleton. The oil is then pressed out and later refined. The meal is then dried, cooled, and run through a grinder to break up bony particles. The meal is then sacked ready for shipment. There are minor variations in the application of the press method but the chief differences between plants are in the method of drying the meal rather than in the manner of pressing out the oil. One of the variations in method of drying will be described later. In order to give a more consecutive idea of the different steps in the reduction of fish to meal, it will be helpful to consider a description of a typical plant using the common press method for sardine offal.

A typical plant of the press type.

The plant selected for description as a typical fish reduction plant, is one operated in conjunction with a Monterey sardine cannery. The reduction plant normally receives 30 tons of sardine offal per day, although it is capable of handling much larger amounts if operated continuously through the day. The fish material is almost entirely sardine offal from the cutting tables of the cannery with the broken and under sized whole fish that naturally result from canning operations. The offal from the cannery is collected in a large storage bin from which a belt and bucket conveyor transports it to the top floor of the reduction plant building. The offal is about 45 minutes in passing through the plant from this storage bin to the drying floor as finished meal, but only a small amount may be run through at a time. Therefore the belt conveyor from the bin has small buckets that feed in only the proper amount of offal.

Cooker.

The older plants of Europe used to cook the fish in vats over a wood or coal fire but steam cooking is the common method now used in California. The cooking is done in a steam chamber or stationary horizontal cylinder roughly two and a half feet in diameter by 18 feet long and insulated with asbestos packing to conserve the heat. Offal is carried through this steam chamber at a uniform speed by means of a revolving auger action conveyor shaft whose revolutions are so timed that the fish remains in the chamber about 15 minutes. This revolving conveyor carries the cooked fish to the press.

Press.

The common form of press used in this state is a horizontal continuous screw press said to be a modification of the French olive press. The press is an auger shaped screw working into a metal jacket which is perforated with openings about the size of a pin hole to allow the water and oil to escape. The screw press is about seven feet long. The first three feet of the press casing or jacket is of lighter construction, with relatively larger holes for the purpose of draining off the free water. In the last four feet, or press proper, there is another screw revolving more slowly, and the distance between the auger flanges is reduced so that the material moves forward more slowly. This slowly revolving screw works against a deeply beveled stationary disk which blocks the forward progress of the material and allows it to escape very slowly in the form of a coarse paste scraped from the beveled edges of the disk. The escaping oil and water are caught in a drip pan and piped to tanks.

Dryer.

The pressed material, now in the form of a paste-like mass, must be dried to prevent moulding and souring. Drying is done by hot air. In this particular plant the drying is done by passing the fish through two horizontal stationary drums or cylindrical chambers each 30 feet long. A circulation of hot air from the furnace is forced through these drums or "dryers" by means of a rotary blower. A vent up the smokestack, provided with rotary section fan, carries off the moist air.

The fish paste drops from the end of the press into an auger conveyor and is carried through the first dryer. It then drops to the second reversed conveyor and passes back through the second drum, which is situated directly under the first. The material is now in the form of a somewhat moist, steaming hot meal. From the end of the dryer the meal enters a piped cold air blast which serves primarily in cooling the meal, but also transports it to the grinder. The press and the dryer break up the fish very thoroughly so that very little grinding is necessary except for occasional bones. The meal passes through a small motor driven grinder and drops on the floor where it is spread out for two or three days to complete the cooling process and to dry out more completely. It is usually shoveled over two or three times on the floor before being sacked in 90-pound sacks for shipment.

Oil recovery.

The oil and water which drain from the press are separated by gravity. The drippings from the press are run through a series of five settling tanks. In the first tank the water and refuse particles are allowed to settle to the bottom and are drained off into the ocean. The oil is syphoned over into the next tank in the series where the gravity separation of the fat from the oil is begun. The top or first oil in the last settling tank is a fairly clear oil but the complete clarifying of the oil by settling out the fat may require several weeks and is unnecessary. The clear oil from the top of the last tank has been used successfully as a paint oil without further refining or the use of a drier in the paint, but this is not the usual practice. The oil is shipped in barrels to paint factories where it is processed for use in paints. This fish oil sells for about one-third the price of linseed oil.

Below the clear oil in the tanks is found the cloudy fatty oils and thick fat material called stearine. The heavier stearine is called "foots." The stearine is sold for use in the manufacture of soap. As stearine contains from 40 per cent to 50 per cent oil it is sometimes heated and more oil drawn off but it usually goes direct to the soap manufacturer.

A modification of the press type.

In the typical plant already described, the fish material, after cooking and pressing, was dried by being carried through stationary drums through which was forced a circulation of hot air from the furnace, by means of rotary blowers. We will consider briefly a plant in which a very different form of dryer is used. In this case the dryer is a revolving drum without a conveyor through the center. A cylindrical drum (five and a half feet in diameter and forty feet long) is placed on a slight decline from the press (pitch of one-half inch to the foot). The hot air is provided by a blast of burning mixture of oil and steam in a firebox so arranged that the flame blast strikes a lattice work of brick allowing only the heated air to enter the drum. A direct flame is not introduced into the drum for fear of scorching the fish. At the opposite end of the drum the necessary air suction is provided by a tall smokestack (four feet in diameter and 60 feet high). On the sides of the drum are a few longitudinal cleats or "channel irons" which serve to tumble the fish material as the drum is rotated. The strong

draught of air and the pitch of the drum from the horizontal, serve to carry the fish waste forward as it dries out. The heavier particles of the dried material tumble out of the back end of the dryer and are caught and conveyed away by a large cold air suction pipe. There are about 200 feet of this air pipe with two rotary blowers so that the material is not only cooled, but is further broken up into fine meal. To prevent the lighter particles from passing up the smokestack, there is a series of three catching, or dust chambers, the operation of which will be described later when considering the volatile solvent method. The meal from the cooling pipes is spread on the floor for several hours for further cooling and is then sacked without grinding. The pressing and tumbling in the dryer and conveyor pipes reduce the material to a fine meal containing only a few bones that have not been completely broken up. In this form the meal is ready for use as fertilizer but it should be ground before used as a chicken food.

Anchovies difficult to press.

It frequently happens that a sardine catch contains a large percentage of anchovies, especially when small sardines are being taken. This is an important consideration because the ordinary screw press will not operate properly with a high percentage of anchovies, especially when the anchovies have been more than eight or ten hours out of water. The soft anchovies churn up in the press as a jelly-like mass that will not feed out and clogs the oil holes and the screw of the press. Anchovies may be used when mixed with sardine offal to lend more body to the material and thus pass it through the press. It is claimed that a mixture of half anchovies and half sardine offal will press fairly well but a lower percentage of anchovies is preferable.

Yield in meal by press method.

The solid flesh of the whole fish yields more meal than a like weight of offal, so that the percentage of whole fish in the offal effects the amount of meal recovered. The degree of fatness of the fish also affects the yield of meal since there is relatively more oil in a ton of offal from fat fish, but there is far less variation in the amount of meal than in the amount of oil recovered. In the typical plant already described the number of tons of sardine offal necessary to make one ton of fish meal varies from five and a half to seven and a half, with six tons as the probable average. The weight of the recovered meal is roughly estimated at one-sixth that of the offal in this plant. Other plants with somewhat different methods estimate the meal at one-fifth to one-fourth the weight of the offal. The remaining five-sixths of the weight is partially recovered as oil and stearine but most of it is water of which the greater per cent is driven off by evaporation. The water content of fresh sardines is high (probably 60 to 75 per cent) and canned sardines are about 60 per cent water but a low moisture content is desirable in both fish meal and oil. The meal contains less than 10 per cent moisture and the oil less than 2 per cent water.

Composition of meal by press method.

Fish meal sells on its chemical composition and frequent samples are subjected to chemical analysis. The chief value of fish meal lies

in its nitrogen and phosphoric acid content. The nitrogen as ammonia is the most important element and the price of a fish meal on the open market is largely determined by the percentage of ammonia present. The ammonia content varies between 8 and 14 per cent, but a high grade meal usually has between 10 and 12 per cent ammonia. The phosphoric acid content as bone phosphate is the next most important consideration in fixing the price. A low moisture content is desirable as the buyer does not care to pay for useless weight in water. The water content is not run below 6 or 8 per cent, not only because of the cost of further reducing the per cent, but also because the sacked meal will absorb sufficient moisture from the atmosphere to bring it up to 6 or 8 per cent. The moisture content of meal varies from 8 to 13 per cent but is usually about 10 per cent. The pressing method does not extract all of the fish oil from the offal and the resulting meal from this process contains from 7 to 10 per cent of oil (ether extract). The chemist's analysis of the meal produced by the typical plant we have considered gives the following results expressed roughly:

Nitrogen	9 to 10 per cent
Phosphoric acid	5 to 10 per cent
Nitrogen as ammonia	10 to 14 per cent
Phosphoric acid as bone phosphate	10 to 22 per cent
Moisture	9 to 12 per cent
Oil (ether extract)	8 to 10 per cent

The term protein is often used in the analyses of meal to include the proteids or nitrogenous matter of the soft tissues of the fish body. Such classifications divide fish meal into protein, oil or fat (ether extract), water and mineral ash. In such cases the protein content ranges from 50 to 60 per cent, a much greater percentage than in fresh fish with its higher moisture content. A rough rule of thumb sometimes followed when the nitrogen content of the meal is given, is to multiply the percent of nitrogen by 5.25 to give the protein content. In judging a fish meal it is essential to know the percentage of (1) ammonia, (2) phosphoric acid, (3) moisture, and (4) oil (given in the order of their importance).

Yield of oil by press method.

In sardines there is a great deal of oil in the flesh just back of the head but the fat about the entrails and the liver itself is especially rich in oil. In cutting sardines for canning, the fish is cut in two near the back of the body cavity and only the posterior half of the fish is canned. Thus the head and entrails are discarded as offal. Therefore a ton of offal will yield more oil than a ton of whole fish and the per cent of whole fish in the material will affect the yield of oil. The greatest source of variation is the periodic fluctuations in the fat content of the sardines themselves. At some seasons of the year they are very fat with a high oil content, while at other seasons, especially in the spring, the fish are thin and have relatively little fat and oil in their bodies. The fat content of sardines varies roughly from 5 to 20 per cent. As anchovies have much less oil than sardines a quantity of anchovies mixed in the offal reduces the oil

yield per ton of material. For the above mentioned reasons the yield of oil varies greatly from day to day and from month to month. In the typical plant we are considering, the oil yield varies from 7 to 27 gallons per ton of offal, with a rough average yield of 10 to 12 gallons of oil and fatty material (stearine) per ton of offal.

Composition of oil by press method.

Fish oil, like fish meal, sells on its chemical analysis. The oil with a small per cent of free fatty acids or unusable material is the high-grade oil bringing the best price. The impurities are referred to in the trade as free fatty acids and M. I. U. The M. is moisture and other volatile matter, the I. is insoluble impurities and the U. is unusable or unsaponifiable matter. The amount of impurities in an oil varies naturally with the method and care used in the refining or settling process. As more care is now being given to this phase of the subject, some of the west coast oils are finding ready sale locally and in the Eastern States. In the past the lack of care in refining and looseness in grading the oil has caused much of the west coast oil to be classed as inferior grade and accepted at a poor price by eastern buyers. For years the Newfoundland and American cod oils were the favorites till salmon oil was found to be equally good. The whale oil business, having been so long established, now has definitely established grades. The sardine oil, being new from this coast, has not yet come fully into its own. The use to which the oil is to be put largely determines the purity of oil necessary. A leading dealer in fish oils makes the general statement that fish oil for use in paints should not have over 5 per cent free fatty acids and not over 2 per cent M. I. U. For tanning purposes the oil should be from 5 to 7 per cent acids and 1 per cent M. I. U., but clear settled (tanked) oil for use in the better grades of soap should not exceed 3 per cent acids and 2 per cent M. I. U. For a No. 1 grade of sardine oil the limit of impurities is usually set at 2 per cent free fatty acids and 2 per cent M. I. U. The press method, with proper care in operating the settling tanks, yields a sardine oil low in acid content and well within the limit as to other impurities. The chemical analyses of the sardine oil produced by such a plant show the following results:

Free fatty acids	.5 to 1.5	per cent
Moisture and volatile matter	.1 to .7	per cent
Insoluble impurities	a trace to .03	per cent
Unsaponifiable matter	.2 to .9	per cent

Volatile solvent method.

In this method there is no press, the oil being recovered by the use of gasoline as a volatile solvent. The elimination of the press permits of the reduction to meal of almost any kind of fish material without readjustment of machinery or extra labor. Fish scraps, trimmings from the fish and abalone markets, offal, meat scraps, whole fish, sharks, squid and anchovies are reduced with equal facility. In the two California plants there is no separate cooking cylinder, but the cooking and drying are combined in one machine. In the press method the oil and water are pressed out and the material then dried. In the gasoline process the material is dried to eliminate the water and later the oil is

extracted from the dried meal. The two gasoline plants of this state are not connected with a fish cannery, but are operated as an independent business, purchasing the raw material from other firms. One plant uses mostly fish scraps and the other, located in one of the sardine canning centers, operates on sardine offal purchased from the canneries. A brief description of the latter plant will better illustrate the method. This plant has a capacity of about 35 tons of offal per day when employing five or six men. With seven or eight workmen the capacity can be increased to 50 or 60 tons per day. The sardine offal is transported to the plant by auto truck and dumped into a storage bin from which a belt conveyor with small buckets carries the material to the dryer. The conveyor is filled by hand so that the amount fed in may be varied according to the directions given by the man operating the dryer.

Dryer.

The dryer (cooker and dryer combined) is a large revolving horizontal cylinder, 40 feet long and 4 feet in diameter, operating on the same general principle as the dryer described above, under "Modification of the Press Type of Plant" which merely dried the cooked and pressed material. This dryer first cooks and then dries the fresh offal from the storage bin. The heat is provided by a burning spray blast of mixed steam and oil, the draught being created by a tall stack. In this case the flame is shot directly into the dryer. The conveyor empties the offal directly into this flame and the four or five longitudinal cleats of the revolving dryer keep it tumbling. The amount of flame and heat may be delicately regulated by adjusting the amount of oil and steam sprayed in. When fairly dry material is being received, the flames extend only two or three feet into the cylinder, but with particularly wet material the flames may be shot into the dryer a distance of eight or ten feet. The wet offal is tumbled in the flame during several revolutions of the cylinder till the material is sufficiently heated to cook the flesh free from the bones. As the moisture is absorbed by the hot air blast and the flames, the dried fish material, being lighter in weight, is blown toward the back end of the dryer. The cylinder is set up with only a very slight pitch downward, the draught being sufficient to carry the fish through. The fish remains in the dryer about thirty minutes from the time of entering the flames till it is blown to the back end of the cylinder as dry meal. The offal is not only cooked and dried in the cylinder, but the tumbling of the dried material breaks it up into a coarse meal, the chunks of which are usually no larger than a pea. In this drying process it is essential that the supply of material being fed into the dryer be uniform, in order to reduce as much as possible the readjusting of the flame. When a great amount of wet fish is fed in rapidly, the drying is not complete and the product is too moist. If the supply of raw material is reduced suddenly, or is much dryer than the preceding supply, the excessive heat burns the fish into hard cakes and extracts free oil, which collects in the bottom of the cylinder and sometimes catches on fire.

Recovery of meal from dryer.

As the back end of the cylinder is open, the meal is blown out into a small catching passage way which has a small hole in the floor to

allow the heavier particles of the meal to escape, but much of the meal is in the form of dust and is carried past this opening by the air current. In order to recover this dust, the air current is led through three dust chambers before it escapes up the stack. The opening into the first chamber is near the top and the outlet near the floor, so that the heavier dust settles to the floor. In the second dust chamber the intake is near the floor and the outlet near the top, so that the finer dust settles in this second chamber. The air current then drops again in a third chamber before escaping up the stack, so that all but a negligible amount of very fine dust is recovered. The dust chambers are emptied once or twice a day by opening a door in the side wall and shoveling up the accumulated fine meal. The dried meal is known as "unfinished stuff," as it has yet to be processed to remove the oil. This unfinished stuff is spread on the concrete floor to cool before it is elevated to the second story of the building in readiness for the next step in the process, the extraction of the oil.

Extraction tank.

The extraction tank is a heavy cylindrical steel tank about nine feet in diameter and about fourteen feet high. The tank is filled through a door in the top to within eighteen inches of the top with the dry unfinished meal. Gasoline is then sprayed in from the top through a perforated pipe till the tank is filled with gasoline sufficient to cover the meal. The tank full of meal and gasoline is then heated by introducing steam at the top of the tank. The heat is said to be about 325 degrees and is continuous for an average of about eight hours. The gasoline begins to take up the oil of the fish meal even before the meal is thoroughly heated, so that the process of draining off the mixed gasoline and oil is begun soon after the steam is introduced. The bottom of the tank is a sheet of steel perforated to allow liquid to drain through it. Under this metal sheet there are alternating layers of charcoal and gunny sacking to catch and hold particles of meal, so that the liquid may be drained off as pure as possible. After this oily gasoline is drained out, the tank is again flushed with a fresh supply of gasoline, which is also drained off. A small door in the side of the tank, even with the metal floor, is then opened and the meal pulled out.

Screening.

The meal that has been removed from the extraction tank is then screened or sifted to remove any of the larger particles that have not been broken up by the process so far. The sifted meal is then ready for sacking. The screenings or tailings consist of pieces of backbone, bones of the skull, especially the cheek plates or opercles, small hard lumps formed by a portion of the intestine, and a few chunks of meal that remain packed or were burned somewhat in the dryer. These tailings may be ground up and resifted, or, as is frequently done, may be run through the dryer again, which breaks up most of the chunks and saves grinding so much material. The tailings, after being ground up into fine particles, are mixed with the sifted meal and sacked. It is essential that the meal be quite dry before sacking. If there is much moisture, the meal will mould and heat in the sack. In case the final meal is found to be too moist, it is run through the dryer again before

sacking. The sacked meal should not have much over 10 per cent moisture.

Recovery of oil.

The liquid drained from the extraction tank is carried by pipe into a smaller tank called the evaporating tank, which is about 12 feet long and 5 feet in diameter. It is provided with a large steam coil capable of heating the liquid to 300 or 325 degrees. The heat volatilizes the gasoline and a pipe at the top of the tank carries off the gas thus formed. After about four hours practically all the gasoline is driven off, leaving only the fish oil remaining in the tank. If much gasoline is left in the oil and the oil is later refined, a serious explosion is apt to result, so that it is essential to drive off all the gasoline possible. The oil is then blown out of the tank by steam pressure and conducted by pipe to a storage tank. The oil is later deodorized by heating to about 600 degrees, which also removes practically all of the moisture and other volatile impurities. The oil is then ready for shipment to the paint manufacturer.

Recovery of gasoline.

The volatilized gasoline escapes from the evaporating tank in a pipe that is run through a condenser or coiled pipe in a bath of running cold water. Ocean water is particularly good for cooling the condenser pipe. The condensed gasoline drains into a storage tank and is ready for use again in the extraction tank. This distilled gasoline is referred to as "high power gas" because of its greater strength in taking up fish oil in the extraction tank. The high power gas has been freed from many impurities and is much more volatile than ordinary commercial gasoline. In fact the commercial gasoline is usually run through the evaporating process to refine it before it is used in the extraction tank.

Composition of meal.

The meal resulting from the gasoline method has practically the same moisture, phosphoric acid, bone phosphate, nitrogen and ammonia content as in the press method. The meal has about 10 per cent each of nitrogen and moisture. The phosphoric acid content is 7 to 8 per cent and the bone phosphate is in the neighborhood of 16 per cent, although quite variable. The ammonia content is 8 to 12 per cent. The chief difference in the two meals is in the oil content. The volatile solvent method removes more of the oil than the press. The final meal by the gasoline method has about 3 per cent of oil as contrasted with 8 to 10 per cent of oil by the press method. Therefore the oil yield per ton of offal is higher by this method than by the press method, the yield being about 20 gallons per ton of offal. The yield of meal is said to be about 23 per cent of the weight of the offal. This yield is as good or better than the percentage of meal recovered from pressing. Practically all of the meal from this plant is sold for chicken food and is shipped to Petaluma.

Quality of oil by gasoline method.

By the gasoline extraction process the resulting oil, although relatively of greater quantity, is not the high quality oil obtained by methods of pressing. When the fish first enters the dryer and is tum-

bled in the flame blast, the oil in the fish is sufficiently scorched so that the resulting oil is black or dark brown, and up to the present time has not been refined to a clear oil. For this reason its use is almost entirely confined to the manufacture of paints, where its color is no drawback except that it is unfit for use in white paint. This dark oil seems to give good satisfaction in colored paints, other than white, even in cream colored paint. The recovered oil has very little of the heavy fatty materials as foots or stearine. So little saponifiable material is recovered that it does not, at present, pay to separate it for sale to the soap manufacturers.

The following are a few of the many bulletins published by the U. S. Department of Agriculture, and may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C.:

Bull. 378. Fish Meal: Its use as a Stock and Poultry Food. (1916.) 5 cents.
Bull. 150. Utilization of Fish Waste on the Pacific Coast. (1915.) 15 cents.
Bull. 2. Fish Scrap Fertilizer Industry of the Atlantic Coast. (1913.) 10 cents.
Bull. 635. Commercial Freezing and Storing of Fish. (1918.)
Bull. 908. Maine Sardine Industry. (1921.) 50 cents.

FIG. 63. Hauling in a sardine net. The wings have been hauled in and the lead line raised, impounding the fish in the bunt of the net. Photograph by Messrs. Higgins and Holmes.

METHODS OF SARDINE FISHING IN SOUTHERN CALIFORNIA.*

By ELMER HIGGINS and HARLAN B. HOLMES.

It is a fixed purpose of the California Fish and Game Commission to maintain a system of fishery statistics so complete and so continuous that the varied and changing conditions of the fishing industry may be compared year by year in order to determine its actual condition and future prospects. As a partial supplement to the statistical records of the catch, collected and compiled according to law, these notes on methods and practices are prepared to aid the investigator in future years to reconstruct in his mind the actual conditions in 1921, enabling him to understand and interpret the figures of the catch.

LOCAL CONDITIONS AND GEAR.

Local conditions have their natural effects upon methods and gear, producing in southern California an industry unique in many ways. The sardine fishery is not an independent industry, for the fisherman engaging in it spends fully half of the year fishing for albacore, tuna, sea bass, mackerel, halibut, or rock cod, and hence his boat and gear are modified to meet the requirements of these other fisheries. By far the greater number of boats fishing sardines are typical albacore boats which are converted for use during the winter sardine season by the removal of bait-boxes and poles. Many, however, of a different type, were built before the albacore fishery became so profitable, and are used, during the off season for sardines, in fishing with trammel nets for halibut, or with set lines for rock cod. These two distinct types of boats are manned, respectively, by the two nationalities which dominate the fishery, the Japanese and the Italians.

Weather conditions also have influenced the type of boats used. Although the boats are perfectly seaworthy and capable of traveling several hundred miles, the uniform character of winds and absence of sudden storms has permitted the development of a type of fishing boat poorly adapted to a short choppy sea, being long and narrow and having a wedge-shaped bow with little flare.

THE LOCATION OF THE FISHERY.

The California sardine, *Sardina caerulea* (Girard), occurs in considerable abundance along the entire west coast of the United States, including Alaska and British Columbia, and southward on the coast of Lower California, but the chief centers of the fishery are Monterey, San Pedro, and San Diego. In southern California sardine canneries are located at San Pedro, Wilmington, Long Beach, Newport Beach, and San Diego, the areas fished covering a radius of fifty miles or so from these points. In the San Pedro district, deep water fishing off a rocky coast is found from Point Firmin north to Redondo and off sandy beaches from Point Firmin south to Newport. At San Diego similar conditions are found to the north, about La Jolla, or from Point Loma south to the Mexican border. The winter sardine fishery is chiefly in

*California State Fisheries Laboratory, Contribution No. 33.

deep water two to ten miles from shore, but in the summer, fish are caught inshore near the sandy beaches.

FISHING SEASON.

The sardine canning industry, which utilizes practically the entire catch in the San Pedro district, depends a great deal upon the large fish 20 to 30 centimeters long, known as "pound-oval" size, from the cans in which they are packed. The fish approach the coast in December and are taken in great quantities until April or May, when smaller sizes become relatively more numerous, but canning sometimes starts early in November, utilizing the smaller sizes of sardines known to the trade as "quarter-oils." (Fig. 64.) The same sizes are taken at San Diego, but a larger proportion of the pack consists of the smaller fish, and the season is therefore somewhat extended.

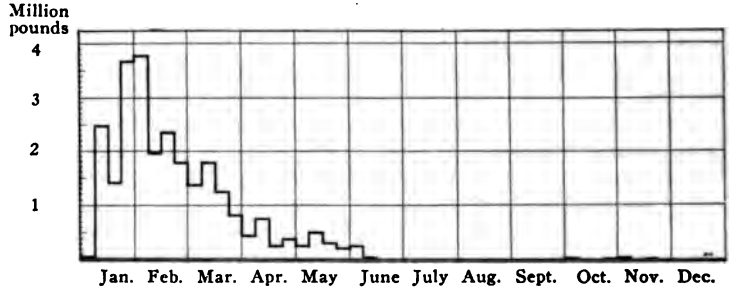


FIG. 64. The 1920 sardine season at San Pedro as shown by the Commission's reports of amounts of sardines received weekly at the canneries.

A summer sardine fishery, scarcely less important economically than the winter fishery, although yielding no statistical record and having no money value, is pursued from Santa Barbara to San Diego. It is the bait fishery, an essential factor in the summer albacore industry. Small sardines of "quarter-oil" size or smaller are highly prized by the albacore fishermen as live bait, and one-half to three-quarters of a ton per boat are taken in the morning whenever possible off sandy beaches before proceeding to the albacore fishing grounds. It is true that anchovies serve as a substitute, but they are not as desirable nor as much sought after as are the small sardines. This bait fishery continues throughout the albacore season, *i. e.*, from June to October. Modified sardine nets called "bait nets" are used and will be described later.

TYPES OF GEAR.

Boats.

As mentioned above, there are two chief types of boats employed in the sardine fishery: one operated by the Italians and the other by the Japanese. Americans (native born), Scandinavians, and Austrians also

engage in sardine fishing, but only in small numbers,* and they use boats which may be classed with one or the other chief types.

The Italians were probably the first sardine fishermen on the coast to use the present style of round-haul nets, and introduced their methods and gear from Italy. Their boats reflect an adaptation to trammel-net or set-line fishing after the sardine season, being smaller than the Japanese boats and having less power and speed.

A typical Italian sardine boat (Figures 65 and 66), carrying a crew of five or six men, is 35 feet long, of 10-foot beam, and 4-foot draft, with a wedge bow and fantail stern. A 20-foot mast is stepped in near the

FIG. 65. A typical Italian sardine boat. These boats are also used for fishing halibut with trammel nets and barracuda with gill nets.

bow, and a low trunk cabin runs aft from this half the length of the deck. The space below is occupied by a two- or three-cylinder distillate engine of 20 to 30 horsepower and sleeping quarters for four. In the afterdeck is a hatch opening into a hold where nets or gear are stored

*The following table gives the nationality of fishermen in southern California, as compiled by the Commercial Fisheries offices of the Commission at San Pedro and San Diego from fishing licenses issued for 1920-21:

Nativity	Aliens	Citizens	First papers	Total	Per cent of total fishermen
Japan	1,025			1,025	42
Austria	357	31	104	492	20
United States		328		328	13
Italy	257	9	15	281	12
Dalmatia	66	5	13	84	3
Scandinavia	51	17	13	81	3
Balkan States	22	4	8	34	1
Russia	16	4	1	21	1
All others (10)	78	15	5	101	4
Total	1,872	423	159	2,447	99
Per cent of total	76	17	6	99	

Austrian fishermen engage almost entirely in purse-seining for tuna, barracuda, and sea bass, while native Americans and many Japanese fish chiefly in the summer for albacore. This leaves the Japanese and Italians dominant in the sardine fishery.

and where rock cod or halibut may be iced or stored fresh, when set-line or trammel-net fishing. The operator stands in the open cabin hatchway amidship, his hands on a small steering wheel inside the cabin and his feet operating the controls of the engine. On some boats a movable box-like hood with glass windows in its sides is placed over the open hatch to protect the head and shoulders of the operator from the weather. The speed of such boats is from six to eight miles per hour and they are relatively economical in operation. Their small size, however, reduces the capacity and their speed limits the radius of operation in the sardine fishery. It also unfits them for the more strenuous duty of catching albacore.

The Japanese type of sardine boat is a modification of the earlier market fishing boat and is built primarily for the catching of albacore. It is longer, speedier, and more powerful than the Italian boats, and more comfort is provided for the operator by building an enclosed pilot house amidship. It is thus adapted to traveling greater distances in search of schools and returning with the catch in less time.

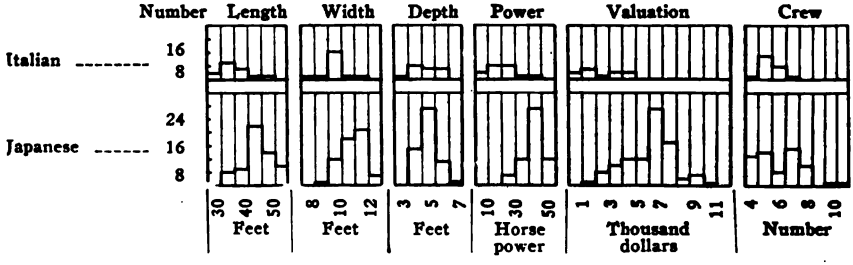


FIG. 66. A comparison of Italian and Japanese types of sardine boats at San Pedro, 1920–21. Data from boat registration records.

A typical Japanese sardine boat (Figures 66 and 73), carrying a crew of seven or eight men, is 45 to 50 feet long, of 12-foot beam, 5-foot draft, and powered with a three-cylinder distillate or crude-oil engine of 40 horsepower, which drives the boat at a speed of from 9 to 12 miles per hour. The vertical bow is wedge-shaped and the stern of fantail type, but broad and rather square. A low trunk cabin with a hatchway on the side runs from near the bow to the pilot house amidship, which is placed directly over the engine. The controls are arranged in the pilot house so that one man operates the boat. The forward cabin is small, having bunk space for two or three men, but extra bunks are fitted in the hold beneath the afterdeck and may be reached through a raised hatch just aft of the cowl or extended roof of the pilot house. A take-down mast set at the forward end of the cabin is carried in a horizontal position, one end resting on the pilot house. The catch of fish is piled all over the afterdeck and along the sides of the cabin as far forward as necessary, and is confined by side-boards which may be built up on the gunwales three or four feet high, according to the size of the load. A space about six feet wide and running athwartship is reserved in the stern of the boat for piling the net and for standing when paying it out or hauling it in again. The

fish are kept out of this area by a low transverse bulkhead or partition which may be built up in the same way as are the sideboards. In the center of this bulkhead is erected a standard bearing an electric light on a swinging arm to light the deck for night hauling.

This is the newer type of boat representing three-fourths of the fishing craft in southern California, and is now being built for fishermen of all nationalities, Japanese and Italians alike, for use in the albacore and sardine industry.

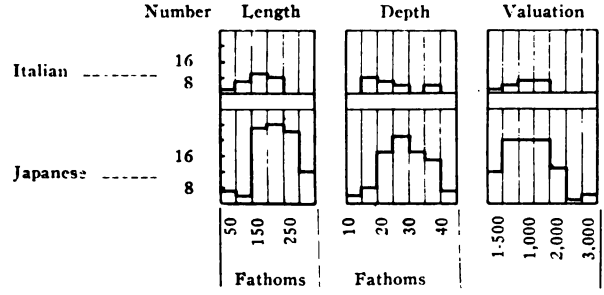


FIG. 67. A comparison of Italian and Japanese types of sardine nets at San Pedro, 1920–21. Data from boat registration records.

Nets.

Sardines are caught entirely in huge nets laid out in circles and hence called "round-haul" nets. Italian and Japanese nets are alike in principle and general plan, but differ in details of design as completely as do the types of boats (Figure 67). Any round-haul net is made in three sections: a right wing, a left wing, and a bunt or bag. The wings are long strips of large meshed net attached at each side of the bunt and are used to encircle the fish and drive them into the bag. The bag is the sacklike center portion of the net, made of fine meshed webbing and used to hold the fish until they may be landed on the boat. The webbing of wings and bunt is fastened to a light rope called the "cork line," buoyed with numerous corks so that the whole net floats in the water with the cork line on the surface. The lower edge of the net is fastened to a similar line—the "lead line"—weighted with leads at frequent intervals. These two ropes, in addition to floating and ballasting the net, take much of the strain of hauling and serve as reenforcement for the edges of the webbing.

Webbing manufactured in Japan is more popular in southern California for making sardine nets than the American or European product, partly, at least, on account of its lower cost. Hard-laid cotton seine twine is preferred for wings and landing sack, and cable-laid twine for the greater part of the bunt, particularly the fine mesh; but notions of economy lead some to use the cheaper and less durable medium-laid twine in the wings.

Each fisherman or boat owner builds his net after his own pattern and according to his latest ideas, producing a diversity of design which no doubt makes for progress in the developing of perfect gear. This great diversity makes it difficult to select a type, and when once

selected it is almost impossible to draw up specifications which could serve in building a net like the original, for net making is an art and can be learned only by experience. Two nets apparently of the same design will fish with different success, due to the individual skill of the makers expressed in the "hang" of the webbing; hence, the accompanying diagrams must not be considered as working drawings, but only as sketches sufficiently detailed, it is hoped, to portray the characteristic points of the types.

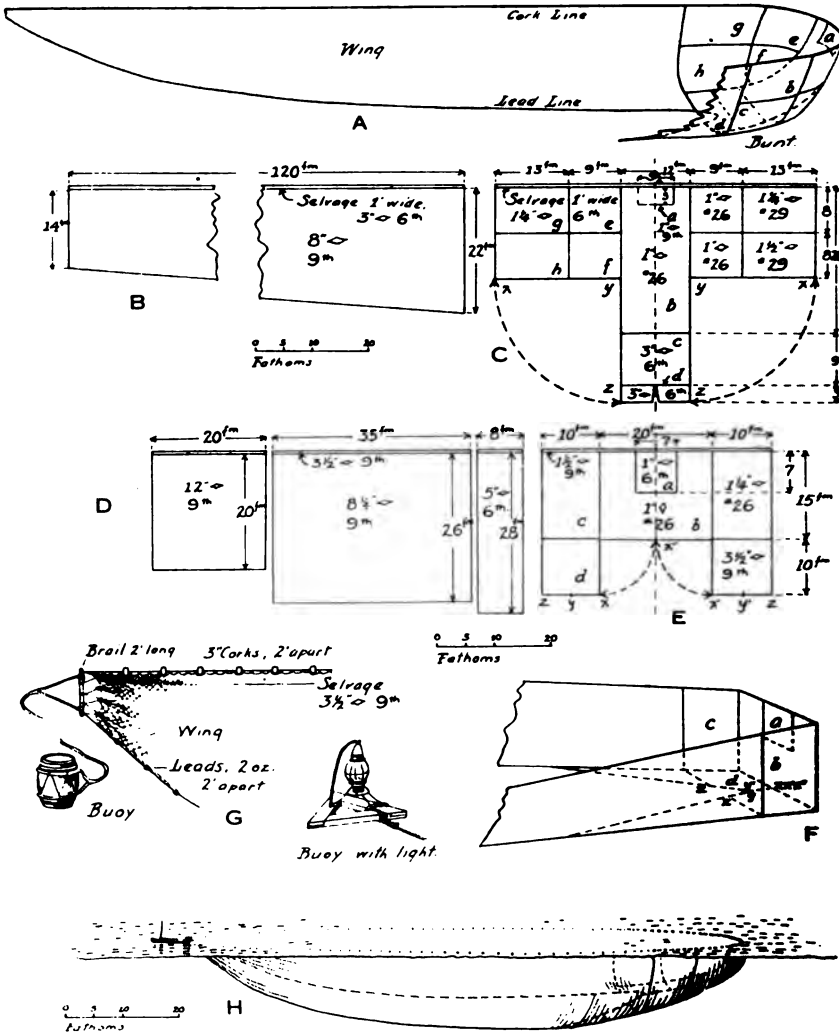


FIG. 68. Diagrams of Italian type of sardine round-haul net or Lampara. A, a perspective diagram of a large Lampara. The right wing only is shown. B, and C, wing and bunt respectively of same, showing pieces of webbing used. The pieces *a*- -*h* are lettered the same in A and C to indicate their relation. The lines *x*-*y* and *y*-*z* in C are brought together to form a bag. D, the wing and E, the bunt of a smaller net. F, the bunt of the same net showing the relation of pieces in E. The points *x*, *x'* and *x''* are brought together and the lines *x*-*y* and *x'*-*y'* are joined as in F. In all diagrams, *a*, is the fine meshed landing sack of heavier twine than the rest of the bunt. G, end of wing and buoys for day and night fishing. H, a large net in operation showing relative length and depth compared with a forty-foot fishing boat.

The "Lampara" or Italian round-haul net.

A typical Italian sardine round-haul net or "Lampara" (Figures 67 and 68) is between 150 and 200 fathoms long, and between 15 and 20 fathoms deep, although some reach 300 fathoms in length and 28 fathoms in depth. The webbing is ¾- or 1-inch mesh of six-thread or sometimes nine-thread twine in the landing bag, and 1-inch to 1¼-inch mesh of No. 26 and No. 29, cable-laid twine in the sides of the bunt. The bed of the net is made of a piece of 1-inch No. 26 cable-laid mesh next to the landing bag and pieces of 2½- and 3½-inch mesh of six-thread hard-laid twine next to the lead line. A strip of heavier webbing about a foot wide, of 1¼-inch mesh and nine-thread twine runs the entire length of the bunt and serves as a selvage to which the cork line may be more firmly hung. A similar piece of selvage runs the length of the wings, but is usually 3½-inch mesh of six-thread, hard or medium-laid twine.

The wings are commonly made of three sizes of mesh, the smallest being near the bunt and the largest at the ends. In a 200-fathom net the bunt is 40 fathoms long and each wing twice as long as the bunt, or 80 fathoms. Of this length, about 10 fathoms is 3-inch mesh, six-thread twine, 45 fathoms of 8-inch, six-thread, and 25 fathoms of 12-inch mesh, nine-thread twine. The piece of 3-inch mesh is fastened to the bunt of the net and is the same depth, *e. g.*, 28 fathoms. Each succeeding piece is reduced somewhat in depth so that the wing tapers to 15 or 18 fathoms at the end. This amount of webbing at the end of the wing is, however, gathered into bunches and fastened to a 2-fathom rope or to a wooden brail 2 feet long. Some prefer more pieces in the wings, beginning with smaller mesh, such as 2½-inch, and running 3-inch, 5-inch, and 8-inch mesh at the end of the wings. Others use 8-inch mesh throughout the whole wing (Figure 69).

FIG. 69. Lampara net stretched on the dock for drying and mending. Fish Harbor, East San Pedro.

The cork line from which the whole upper edge of the net is hung is a ¼-inch manila line carrying 3-inch corks strung through their centers. Double corks four or six inches apart are placed the entire length of the bunt, and single corks, four, twelve, and eighteen inches apart are used on the wings. The corks are placed close together in the bunt and on the first sections of the wings to add greater buoyancy so that the weight of the fish in the sack, when making a haul, is less likely to pull the net under water and thus allow the fish to escape. The mesh of the bunt and wings is "hung full" on the cork line—*i. e.*, the cork line is shorter than the stretched webbing so as to allow for bagging of the net, by that means giving more room inside the bag and making it pull more evenly in the water. The amount of fullness left in the webbing depends upon the ideas of the individual maker. One method is to stretch the cork and lead lines by soaking them all night in water and then hanging the dry webbing upon them evenly the next day. The webbing will then stretch relatively more than the cork and lead lines when in use, relieving it of excessive strain and permitting sufficient bagging of the mesh. Another method is to first stretch the dry cork line, fastening in position temporarily at intervals the required amount of dry webbing, and later hanging permanently. In this way about 45 or 50 fathoms of webbing are hung on 40 fathoms of cork line to give sufficient fullness.

The lead line is also a ¼-inch manilla rope, like the cork line, but is strung with two-ounce leads one or two feet apart along its entire length. This amount of lead is just sufficient to make the bottom of the net fall readily and straighten out in the water.

The Japanese round-haul net.

The Japanese type of sardine net, although introduced into California later than the Lampara, has grown in popularity and now far exceeds the latter in numbers used. The Japanese net resembles the Lampara in a general way, but differs from it in size—both length and depth—in the shape of the bunt, and in the relative proportions of the bunt and wings.

A typical Japanese sardine net is from 200 to 250 fathoms long and from 25 to 30 fathoms deep, although many are 300 fathoms long and from 35 to 45 fathoms deep (Figures 67 and 70). The bunt is from 30 to 50 fathoms along the cork line, and the wings from three to three and one-half times this length. The mesh is commonly 1-inch, nine-thread in the landing bag; ¾-inch No. 26, cable-laid, in the sides of the bunt; 1-inch No. 26, cable-laid, lower down; and 3½-inch, six-thread, hard-laid, in the bed. The wings are made up of three or five pieces of webbing of different size, of from 3- to 8-inch mesh, arranged as in the Lampara and tapering in depth. A strip of heavy mesh or selvage runs the entire length of the cork line, as in Italian net, but, in addition, a strip of two or three heavy 3-inch meshes runs down the sides of the bunt, making a firm selvage for the attachment of the wings.

A special feature used in some Japanese nets is the purse-line or quarter-rope, a ¾-inch rope, one end of which is fastened to the middle of the lead line by a short halter, and the other end to the lead line of one wing about 15 fathoms out. This line is used to raise the middle of the lead line of the bunt more rapidly than could be done by hauling

only on the wings. This is a desirable feature, for as soon as the lead line is raised the catch is made certain, the fish being then confined in the fine-meshed portion of the net.

It is difficult to discuss the relative merits of the two types of sardine nets, as both Italians and Japanese seem equally successful in catching

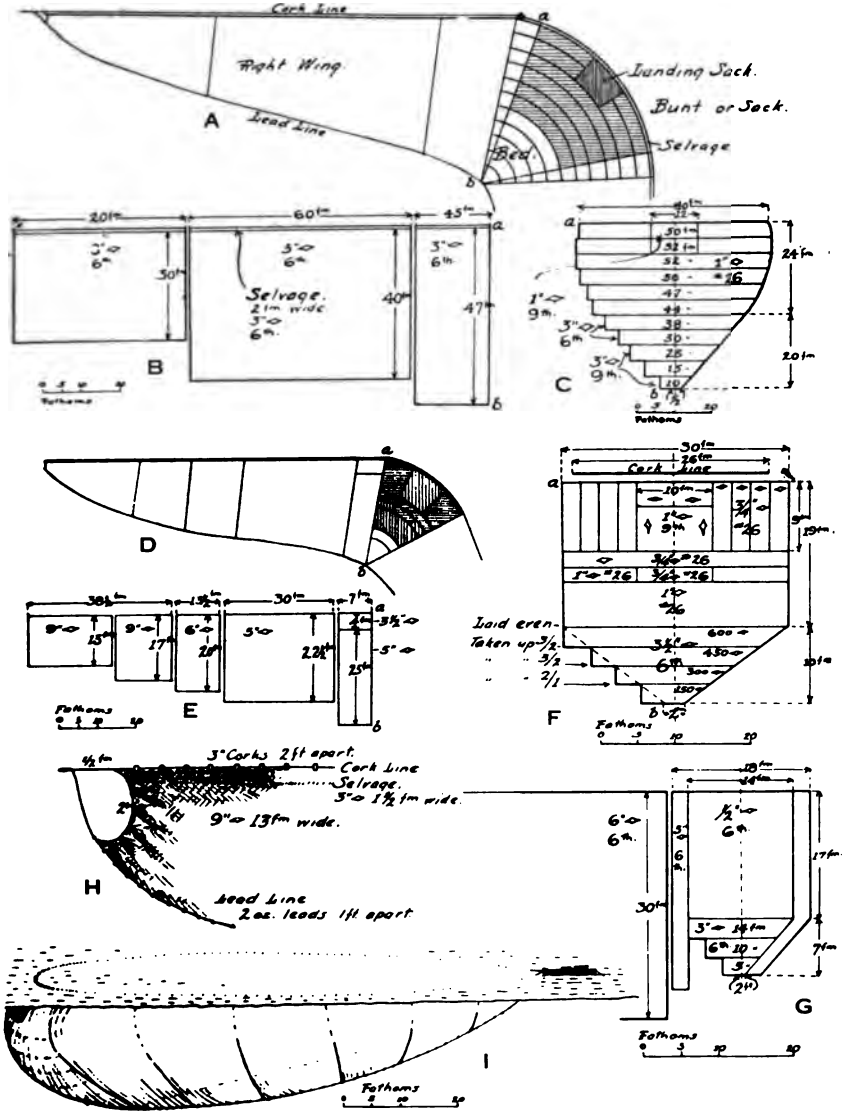


FIG. 70. Diagrams of Japanese type of sardine round-haul nets. A, a large net showing wing and bunt. B, and C, wing and bunt respectively of same, showing pieces used in making. The adjacent edges are brought together evenly by taking up the longer into the shorter lengths. The left side of C shows the pieces stretched and the right side after being taken up. D, a smaller net; E, and F, wing and bunt of same. Many more pieces than indicated may be used in the wings to produce the proper taper. G, the bunt and part of the wing of a bait net. H, method of fastening the end of the wing. I, a net in operation showing relative length and depth compared with a fifty-foot fishing boat.

fish. The popularity of the Japanese nets may be due to the great increase in the number of Japanese fishermen who naturally use their own methods, and the acceptance of this type by other nationalities may be due to its relatively simple design. It is argued that the greater depth of the Japanese type makes the net more generally useful than the Italian, since it can be used in deeper water away from shore. It is further said that the smaller amount of fine-meshed web in the Japanese net reduces the cost of construction and allows the building of a larger net with greater fishing capacity without corresponding increase in cost. Other fishermen declare that it is less difficult to operate a Japanese net, as cross currents are less likely to close the bag than is the case with the Lampara, and that the greater proportion of large mesh makes the net easier to pull. Whatever the facts may be, the fisherman of each nationality stoutly maintains his belief in the superiority of his gear, and both types will probably exist as long as Italians and Japanese continue to fish for sardines.

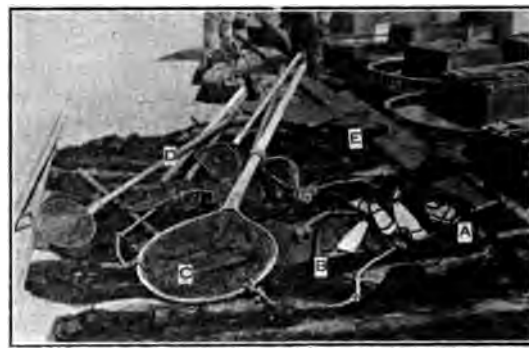


FIG. 71. Miscellaneous gear. A, and B, line and weight of the scare, with paddles piled between; C, dip-net for landing the fish; D, shovels used in unloading; E, side boards and checks for confining the catch on deck.

Bait nets.

The bait net is an important modification of the standard sardine gear. It is an almost necessary piece of equipment for the albacore boat, for live bait is required daily during the summer season. Some fishermen, moreover, make a practice of supplying small sardines to the market to be used as bait for the mackerel and set-line fisheries, and for this, bait nets are used. Bait nets are small sized Lamparas or Japanese style round-haul nets ranging from 75 to 150 fathoms in length and from 12 to 20 fathoms deep. They are usually more simple in construction, fewer pieces of webbing being used. The webbing in the bunt is of $\frac{1}{2}$- or $\frac{3}{4}$-inch mesh, but the mesh of the wings is about the same as in the larger nets.

Miscellaneous gear.

Many other kinds of gear may be mentioned which are used directly in catching or handling sardines, such as buoys, skiffs, plungers or scares, and dip-nets (Figure 71). A brief description of each will be given here, but details of their use will be left until later in this paper.

The Italian fisherman uses a red-painted, five-gallon keg as a buoy to float and mark the end of his net when fishing in the daytime. For night fishing, either a similar keg, weighted, and carrying a lantern, or a simple buoy made of crossed pieces of wood so as to float level and carry a light, is used. The Japanese, however, tow a twelve-foot skiff, lighted with a lantern at night, behind their fishing boat, to be used in place of the buoy.

The scares or plungers used in driving the fish back into the net are of many kinds. The simplest form is a weighted board two or three feet long, fastened to a ten- or fifteen-fathom line. Another kind used on some boats is a two- or three-foot length of iron pipe, open at the lower end but fitted to a short wooden pole at the other. This is also fastened to a light line so that it may be thrust down and rapidly hauled in again. Still another type is made by weighting one end of a long rope with a ten-pound window weight and fastening eight or ten white-painted wooden paddles about ten inches long and four inches wide at fathom intervals along its length. This seems to be a very efficient scare, as the paddles dash about irregularly when the line is jerked up and down in the water.

Two kinds of small ring nets are used: one is a dip-net for bailing the fish out of the water, the other really a shovel for unloading the catch. The dip-net is a shallow bag of heavy 2-inch webbing fastened to an iron ring two or three feet in diameter which is fixed on a heavy pole or handle about eight feet long. Short lengths of rope are fastened to either side of the ring to help in lifting the net filled with fish on board the boat. Another rope is fastened to the bottom of the net and is used in dumping the fish by raising the bag. The small nets used as shovels are made of heavy mesh stretched tightly over iron rings ten inches or a foot in diameter, with wooden handles four feet long. They may be circular, square, or semicircular, with the flat side away from the handle to make it easy to shovel up the fish from the flat deck. These particular implements are used instead of iron shovels to avoid cutting or bruising the fish more than necessary in unloading.

Care of gear.

Sardine nets are continually in need of mending. Defective meshes giving away causing small tears, large fish becoming entangled or plunging through the net, hidden snags—a hundred causes—keep the fisherman mending and mending before and after hauls and while waiting to unload the catch. Frequently the weight of the fish caught in the net is so great that rents are made great enough to allow the whole catch to escape. If possible, the repairing is done on the boat, but if the damage is too great the net must be spread out on the dock, and the whole crew goes to work with full-wound seine needles to repair the tear.

The standard method of preserving net material is by tanning the webbing in a hot decoction of red-oak tan-bark (Figure 72). Two sacks, or 120 pounds of bark, is placed with 100 gallons of water in a large tank and boiled for one hour. The fluid is allowed to cool somewhat and the net is put in and soaked for two hours or more, at a temperature less than boiling. Care is exercised to avoid heating too much, as the net is said to burn, causing quick "rotting" of the fabric.

Many canneries provide vats for tanning, heated with steam coils, but where the fisherman does not have access to such equipment he heats his tanks of tanning solution with a wood fire built in a pit in the ground. Nets are never tanned before storing away at the close of the season, but only while in actual use, for it is believed that rotting is more rapid when an excess of tan is left in the fabric.

Nets are dried as frequently as possible as a precaution against rotting, and windy days or periods when fish are scarce are always occupied with spreading nets on the docks or on the sandy ground for drying and mending. Rotting of the net when wet is also guarded

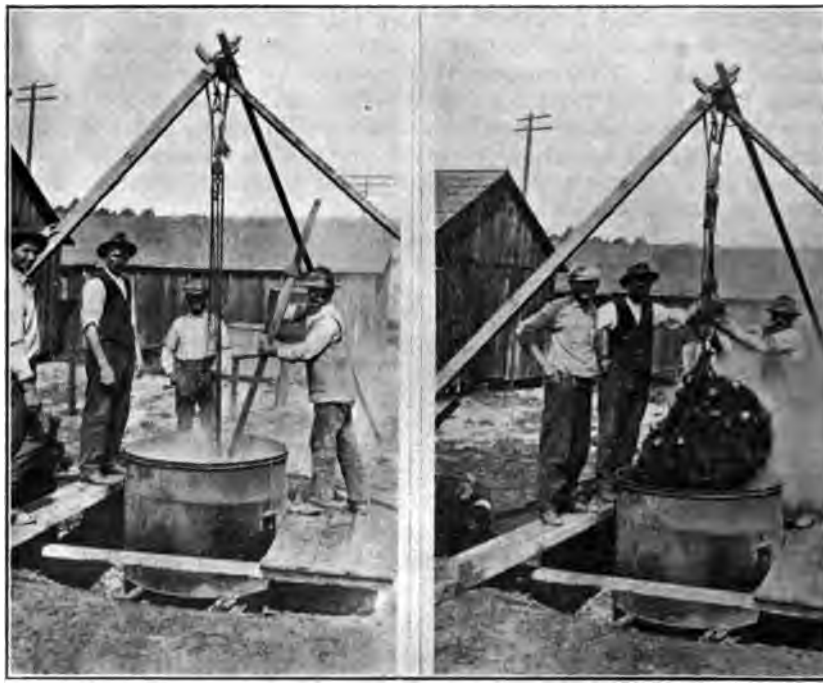


FIG. 72. Tanning nets. The nets are preserved from mildewing by soaking for several hours in a hot decoction of tan bark.

against by careful protection from the sun. As soon as the day's catch is made, the net is piled in order and covered with a tarpaulin made of heavy canvas.

Cost.

With ordinary care, a sardine net will last for two fishing seasons, but during the third season it is usually necessary to replace so many pieces of webbing that the net can hardly be called the same as the one at the start. A sardine net at the prevailing prices of the last two years, represents an outlay of from $1,000 to $3,000, but the cost of continual repairs makes the annual cost of operating a net from $300 to $1,000.

METHODS OF FISHING.

Time.

It is the fixed opinion of some that day fishing yields more mixed or small sizes of fish than night fishing; others notice no difference. Large and small fish are caught both day and night, but it may easily be true that differences in the schooling of the fish make the larger fish more accessible at night and so increase the average size of the fish in the total catch. At any rate, the demands of the canneries for large fish—pound oval size—combined with the greater accessibility is responsible for the greater part of the sardine catch being taken at night. The fish are most easily located on the darkest nights, hence, the two-week period during the dark phases of the moon is most successful. Day fishing is only resorted to when less than two or three hours of darkness is left between nightfall and moon-rise or moon-set and dawn. When fishing in the day time, the hours of early morning are the most favorable as the schools of fish can be most easily located when the water is calm.

FIG. 73. Searching for schools of fish. The crew on the bow and the man on the pilot house anxiously scan the sea for birds, darkened areas of water, or ripples on the surface which indicate the presence of fish. A typical Japanese boat.

Locating the school of fish.

The schools are located at night by the phosphorescent light produced by the movement of the fish in swimming. This explains the dependence of the fisherman upon the phases of the moon, as even a small amount of moonlight, or even bright starlight, makes it difficult at times to see the pale light of the phosphorescence. The running lights of the fishing boats are even darkened by covering them with cloth so that they may be seen at a short distance by other boats but will not give enough light to obscure the evidence of fish. Very dense schools may often be located at some distance by the dull "fire" but when the fish are more scattered it is necessary to pass over them to discover their presence.

Smelt and anchovies school closely enough and are near enough in size to be mistaken for sardines by the ordinary observer, at least at night, but the fisherman distinguishes between them readily by the courses of the fish as they dash away from the boat. Smelt swim away

in undulating courses leaving wavering, snaky trails of light. Anchovies, being feebler swimmers, dart away in short, curved dashes. Sardines are more powerful and dash away, leaving long slightly curved trails resembling the luminous paths of sky rockets.

There are several ways of locating sardines in the day time (Figure 73). A school may be discovered at a distance by seeing the gulls, fulmars, and shearwaters flying in circles and feeding upon the splashing fish. The water may also appear dark from the mass of fish below, and at close range the fish may be seen splashing on the surface. The character of the splash serves to distinguish sardines from anchovies, the former throw their tails above the surface without a marked silvery flash, while the latter flip over sidewise on the water showing their silvery sides and reflecting flashes of light. Some fishermen locate deep-lying schools in quiet water by the "bead"—minute bubbles which come up from below and bead the surface of the water like rain drops.

Making a haul.

Having located a school of fish dense enough to warrant an attempt, the crew stands in readiness to lay out the net while the skipper, noting the wind and current, circles and maneuvers the boat into proper

FIG. 74. Hauling in the wings. The activity here shown is accompanied by the excitement one feels before actually landing any other kind of fish.

position. The net is always laid out in relation to the direction of the wind so that the boat may not blow back over the net, and to the direction of the current, so that the net may not be swept shut or prevented from opening fully.

In making a haul, the net is laid out in a huge circle about the school of fish, the ends brought together and hauled in, impounding the fish in the bunt of the net. Running ahead at full speed, the skiff is released or the buoy thrown overboard, and its weight drags the end of the net into the water. The net is piled in the stern of the fishing boat so that one wing is paid out first, cork line and lead falling far apart in the water so as not to tangle. When one wing is paid out, the whole pile of bunt is thrown overboard at once, and the second wing is then dragged out by the weight of the net and speed of the boat. When the net is nearly all overboard the boat slows down in preparation for picking up the skiff, but should all of the net be paid

out before the skiff or buoy is reached, a one-inch line already attached to the net is slacked away under strain as far as necessary, and then hauled in again when the other wing is reached.

As soon as both ends of the net are recovered, the launch is anchored at once, if in shallow water, with a light kedge anchor, the skiff tied

FIG. 75. Sardine fishing in the black obscurity of midnight. This is the typical condition under which ninety per cent of our sardines are caught. Above, hauling in the bag; below, dipping the fish from the net.

forward out of the way, and all hands immediately begin hauling in the net with all possible speed (Figure 74). Care is taken to pull both wings at the same rate, cork line, lead line, and webbing coming in evenly; and as an aid, marked corks are placed on each wing at equal distances from the center. While the wings are being hauled in, one man operates the scare or plunger described above. This scare is

jerked vigorously up and down at the stern of the boat to frighten the fish back into the net and prevent their escape from the open side beneath the boat.

The wings of the net are hauled in until the lead line, being shorter than the cork line, is brought on deck. Thus far all work has been performed in absolute darkness, every light on the boat being entirely darkened so as not to attract the fish toward the boat and out of the net, but as soon as the lead line is brought on deck making escape impossible, the deck lights and running lights are turned on (Figure 75). The weight of a large catch of fish in the bag is sometimes sufficient to pull the cork line under water, allowing many of the fish to escape. The Japanese prevent this by one man rowing with the skiff to the outer side of the net and supporting the cork line. (Figure 63). He later helps operate the dip-net in landing the fish.

FIG. 76. Bailing the fish from the net. Two boats have come together to load from one successful haul. The men in the skiff dip the fish from the water while two men on each fishing boat hoist the nets on deck and dump them.

The hauling in of the mesh of the bunt continues until the fish are crowded into the landing bag and their weight makes further hauling too difficult. The cork line is drawn up into a circle about ten feet in diameter and partially supported by boat hooks. The fish are then bailed from the net with a large dip-net, dumped on deck, and shoveled forward to make room for subsequent hauls. Three men work together with the dip-net in landing the catch, the others holding the net by sitting on the webbing and spreading the cork line with boat hooks. Often two boats will come together and take their loads from one successful haul (Figure 76).

Preparing for the next haul.

As soon as the catch is landed and disposed of on the deck, the bunt is sometimes roughly washed to remove excess scales and slime, serious tears are temporarily mended, and the wings and bunt piled on deck in preparation for the next haul. It is the practice of most fishermen to circle to the right in laying out the net. When this plan is followed, the left wing of the net is carefully coiled on the port side of the stern, cork line and lead line well separated. The bunt of the Japanese net is piled on top of this, but the bunt of the lampara is piled separately next to the wing so that the whole pile may be thrown overboard at once, avoiding strain on the webbing which might tear the net. The right wing is then coiled to the starboard so that when the skiff is released or the buoy thrown out, the net will pay out freely. On boats which circle to the left, this arrangement of the net on the deck is reversed.

Size of hauls.

The quantity of fish taken in a single haul varies between the many, many weary hauls containing nothing, and the rare streaks of fortune containing over one hundred tons. The capacity of the larger Japanese boats does not greatly exceed twenty-five tons, and when such large hauls are made other boats are called and loaded from the overabundance. During the present season, limit catches of ten to fifteen tons could frequently be taken in one haul, but at times boats whose weary crews had made eight or ten hauls would return from a night's fishing with a ton or even less.

The Fish and Game Commission has legal authority to prevent wastage by limiting the size of the loads according to the tonnage of the boats, for if the fish are piled too deep on the deck, heating and pressure on

FIG. 77. An "idle" moment while waiting to unload. Seine needles are busy with never-ending repairs on the net.

the lower layers renders a large part unfit for canning. During the past season, however, the amount used for canning was small and the surplus was converted into fish meal. The only limits imposed on the catch, therefore, were those required by cannery practices.

Disposing of catch and washing net.

As soon as the night's catch is taken, the run to port is made without loss of time, as the first boat to tie up at the cannery hoist is the first to unload. Most of the canneries start receiving fish at seven o'clock in the morning, but by daylight a long row of loaded boats is tied up, side by side, waiting their turn at the hoist. If the boat gets in before morning, the entire crew will turn in for a few hours sleep on the boat, or if living near the water front, will go home, estimating by the position of their boat in the waiting line the hour to return. But if the boat arrives late and is required to wait but a short time before unloading, the crew sets to work with ever-ready seine needles mending holes in the net (Figure 77).

FIG. 78. Unloading the catch. The fish are shoveled into the hopper where they fall into buckets to be hoisted into the cannery.

The boat is unloaded by shoveling the fish into the cannery hoist with the small net-like shovels described above. The fish from the after-deck space are first unloaded and when these are gone, the ones piled forward along the sides of the cabin are sluiced down to the after-deck with running water from a hose. Six or seven men are able to discharge an average load in about a half hour at canneries using a continuous conveyor, but more time is required where a single bucket hoist is used (Figure 78).

As soon as the boat is unloaded, the deck and deck houses are thoroughly scrubbed with running water and the side boards thrown into the water to remove scales and slime. The boat then backs out of line to allow the next boat to be pulled up to the unloading hoist, and runs outside away from the canneries to wash the net. The pieces of kelp and occasionally gilled fish are carefully picked out of the webbing, and the bunt thrown overboard and dragged through the water for some distance to wash out the slime. The crew then slowly hauls it in, shaking

and sousing the webbing repeatedly to complete the cleaning. Thoroughly washed nets last much longer than carelessly cleaned ones, and thrifty skippers are very particular about the amount of shaking and rinsing their nets receive after each day's work.

Thus it may be seen in following the course of operations, that sardine fishing, even under the mildest and most favorable of natural conditions, entails long hours, heavy labor, and uncertain returns. Only those who are born to following the sea are attracted by the possibilities of fishing, and hence the industry has fallen into the hands of those from foreign lands where fishing is a profession, and not a mere means of living.

CALIFORNIA SARDINE FOOD PRODUCTS AND THEIR PREPARATION.*

By Harry R. Beard.

The outbreak of the World War in 1914 brought about a large increase in the demand for food products. Normal production of most foods require time and the use of valuable raw materials. The world's fisheries, however, were furnishing large quantities of excellent food without such serious drawbacks. Moreover, this supply could be greatly increased and, by using methods of preservation, it could be

Fig. 79. Sardine cannery.

made available anywhere. In addition, the increased quantity of by-products from fish would be of almost equal importance. This is obvious when one considers the things which may be derived wholly or in part from fish wastes. Some examples are: fertilizers, stock and chicken food, glue, oil, glycerine, soaps, explosives, paints, waterproofed fabrics, lubricants, medicinal products, salad oils, butter substitutes, candles, artificial jewels, and ornaments for hats and dresses. Demands for food and for these products naturally led to a vast expansion of the fish industry.

An excellent example of this expansion is shown by the rapid growth of the California sardine industry during the war period. In 1920

*Contribution from Preservation Laboratory, Fish and Game Commission of California, San Pedro.

California's production had risen to a place where it was almost leading in the race for world supremacy. In addition it can be said, that California canneries are second to none in sanitation, equipment, methods of packing, and in the variety and quality of food products produced.

A short description of these products, their preparation and food values follow.

FOOD PRODUCTS.

The sardine packer offers to the trade excellent food products put up in ways various enough to suit any taste. Moreover, most of these products are sold at prices low enough for everybody. The canned products enjoying the greatest popularity are the so-called "pound oval" and "quarter oil" packs.

A can of "pound oval" sardines usually contains four to seven large sized fish which have either been steamed in the can or fried and then packed into a flat oval can with tomato sauce. This is the cheapest and most popular pack put up by the industry.

Next in order of importance is the "quarter oil" pack. Here one finds fried "baby" sardines tightly packed with olive oil into quarter-pound flat cans.

Many other products are put out in smaller quantities. These depend upon the resourcefulness of the packer and the demands of his trade. For instance, the size and shape of the can is varied as well as the size of the fish put into it. Sauces placed in the can include, in addition to tomato, mustard, souse (vinegar and spices), and soy for the orientals. Fancy packs are prepared by making fillet of sardine, by smoking to add the delicate flavor obtained in that manner, by grilling, by packing in glass, and by making mixtures with other foods. Considerable quantities of salted, pressed sardines are sold to the foreign trade.

PACKING.

Sardines are canned in modern packing establishments situated on the waterfront close to the fishing grounds. The size of different plants varies greatly. Some are able to handle only a few tons of sardines a day while others can easily care for 100 tons in the same period of time. The internal arrangement of space and equipment differs in most canneries, yet in each case the arrangement was planned to expedite the process.

Mechanical equipment of the latest type is used wherever possible, making the procedure mostly automatic in the larger plants.

Particular attention is paid to sanitation in all canneries. Cement floors are used to a great extent, as they are easily washed after a batch of fish has been cared for. The fry-baths, trays, and packing tables are cleaned after use by treatment with a solution of soap or caustic soda followed by plenty of water. The women who pack the fish into cans wear white aprons and caps. They are required to keep their hands clean and their nails manicured. Precautions of a like character are required of all personnel who handle the fish.

The methods used in preparation and canning of fried "pound oval" sardines are representative of those generally used in California for preparing most canned sardine products. These methods will,

therefore, be given in detail. Following this description, a few general statements will be made concerning the preparation of steamed "pound oval" sardines and of the other packs which have been described above. In these connections, it is to be kept in mind that the methods given here are subject to considerable variation in the many canneries. These changes, however, are only different means of attaining the same end.

Description of a process is probably made clearer if it is treated according to the steps into which it naturally divides itself. This plan is used here in describing the preparation and canning of the "pound oval" pack.

Preparation and canning of the "pound oval" pack.

Receiving. Sardines are received fresh from the fishing grounds, having been rushed to the canneries to prevent decomposition. They are shoveled from the boats into a mechanical hoist which raises them to an elevated platform where they are weighed. Water and gravity then carry the fish from the weighing vat through a trough into the cannery proper.

Scaling. The first operation in preparing sardines for canning is to scale them. This is accomplished by passing them through a large cylinder of heavy screening, which is rotating in a tilted position. Most of the scales are removed by the rubbing of the fish against each other and against the screen wall of the cylinder. Water is sprayed on the fish at the same time to help remove the scales and to wash the fish. The sardines are discharged on the cutting tables.

Cutting. In at least one cannery in the state an attempt is being made to cut sardines by a specially devised machine. However, this is an experiment. Cutting is usually done by Japanese women. They are paid by the number of buckets of cut fish delivered to the checker, who keeps score by punching a card, which hangs on the cutter's back. Cutting, therefore, develops into a sort of race: each cutter trying to make more money than anyone else. In some cases a cutter makes as high as a dollar and even more per hour when the price paid is thirty to thirty-six cents per hundred pounds of cut fish.

This sort of a race is desirable, as the fish do not tarry long on the cutting tables. In addition, a large number of cutters are employed, so the period only lasts a few hours.

The cutting operation is carried out in the following manner: The fish is taken from the table with one hand and held belly down on the cutting board. One cut with a sharp knife suffices to remove the head and part of the body from the sardine. A sideways motion with the knife removes the entrails and forces all the refuse through a hole in the table. At the same time, the other hand drops the cut fish into the bucket. The refuse from this operation goes to the by-products plant, where the oil is removed and the residue is made into fish meal.

Brining. The cut fish are placed in a large wooden vat containing an almost saturated solution of salt in water. The fish remain immersed in this brine for about thirty to sixty minutes. The time used varies according to the strength of brine, the temperature, and the size of the fish. A man skilled in brining determines when the fish have been brined sufficiently by observing their appearance.

Brining accomplishes several things. Some water, blood, and soluble proteins are extracted. Salt goes in the other direction, penetrating the flesh and making it firmer.

Drying. Brined fish normally contain too much moisture to fry and can well, so the excess is removed by means of hot air.

The apparatus usually used is a tunnel drier. This consists of an elongated chamber, varying from the size of a small, narrow room to

FIG. 80. Sardines coming from the dryer.

the size of a large hallway. Large fans rapidly blow or suck air through a series of steam coils, then through the chamber. In one popular type of drier the sardines pass through the chamber once on an endless wire belt. In their passage they are subject to hot dry air forced down onto the fish by baffle plates. In another type an endless wire belt carries the sardines to the top of the drier and through it. They then fall on a belt traveling in the opposite direction. A set of belts placed one below another repeats this operation several times before the fish leave the drier. In some types belts are not used. Instead of such apparatus, tiers of trays containing sardines are wheeled on trucks into the chamber and allowed to remain until the degree of drying is complete enough.

The time necessary for sufficient drying depends mainly upon: the rate, temperature, and moisture content of the air used; and upon the size of the fish. The time is easily controlled by changing the speed of the belts. Where trays are used the method of control is obvious.

In most cases an hour or less of drying is sufficient. The appearance of the fish is used as a guide in determining the sufficiency of this operation.

Frying. The sardines are conducted from the drier to the fry-bath, where preliminary cooking is accomplished.

Shallow wire trays are partly filled with the dried sardines (if they are not already in trays) and slowly passed through cottonseed oil heated to a temperature ranging from 215 to 240 degrees Fahrenheit.

FIG. 81. Frying sardines.

The apparatus used consists of an elongated metal vat, inside of which is placed, midway of its depth, a horizontal set of steam coils. An endless chain conveyor runs just above the steam coils, carrying the baskets of fish through the length of the bath. Water is added to the bath until it almost comes to the bottom of the steam coils. Enough oil is then floated on top of this water to cover the baskets of fish which are to be carried through it. At times this amount of oil is over a thousand gallons. The temperature is controlled by varying the amount and pressure of the steam which is sent through the coils immersed in the oil.

Frying in pure oil brings out the excellent sardine flavor. In addition, part of the oil is carried on by the fish and this adds to the delicacy of the final product. This operation removes considerable moisture and some soluble extractives from the fish. Part of this water goes off as steam. The rest sinks with the extractives and solid particles coming from the fish. These collect in the layer of water

under the oil. After a day of frying the oil is separated from the water and other waste materials. The bath is then cleaned before the oil is returned to it.

The condition of the fish is used in determining the correct amount of frying. If, after removing the tail and holding the fish in one hand, the backbone can be removed easily and cleanly and shows no uncooked blood, then the process is deemed sufficient. Around eight minutes is the time needed for frying "pound oval" sized fish when the temperature of the oil is close to 230 degrees Fahrenheit.

The trays coming from the hot oil are placed on trucks and allowed to remain there until the fish drain and cool.

FIG. 82. Packing sardines.

Packing. After sufficient cooling the trays of sardines are placed on the packing table where women discard the broken fish and pack the others into clean cans.

The packing table is in a clean, light, airy part of the plant. It is arranged so as to give individual working space to each woman who has a tray of fish and a box of cans within her reach.

The cans come through a chute from a different part of the plant or they are brought in in cases. Each woman has a card which is punched every time she receives a case of cans. This is used as the unit of pay for her work. Some of the women make as high as a dollar or more per hour when the price paid is thirty cents per hundred cans packed.

The women carefully pack the fish into cans and then place them on a belt conveyor which carries them past an inspector, who discards the poorly packed cans. They then go to the sauce distributors.

The steady stream of cans on the belt conveyor passes under a mechanical sauce distributor which adds the correct amount of tomato sauce to each.

Exhausting. When cold sauce is added to the cans they are heated before they are sealed. This is necessary to prevent trouble later. Explanation of this is easily given. Cans sealed cold on a cold day have all empty spaces full of cold air. Later when a hot day comes the air expands and the cans swell. Addition of hot sauce followed by

FIG. 83. Sealing cans of sardines.

immediate sealing cares for this difficulty. Another method of accomplishing the same end is to exhaust the cans by heating them after the sauce is added. This is brought about by allowing them to continue on the belt conveyor through a narrow chamber long enough to permit the steam pipes contained therein to heat the contents thoroughly.

Sealing. The cans are carried on the belt conveyor to an automatic sealing machine, which literally picks one of them up, puts a lid on it and with a whirl seals the lid to the can. Some machines do this forty or more times to the minute. The can carries a flange which fits into a groove in the lid having an extended edge bent downward. In sealing, the flange of the can and the edge of the lid are interlocked so as to form a double seam. The groove in the lid carries a very thin

layer of a sort of rubber compound, which serves as a gasket between the seams.

The cans fall from the machine into a large metal truck. This truck, which holds a very large number of them, is made to fit the retort used in processing.

Processing. Sterilization of the contents of the can is necessary to insure its keeping qualities. In addition more cooking is desirable. Proper heat treatment accomplishes both of these steps at one time.

The truck containing the cans from the sealing machine is wheeled into a large steel retort. The door is then tightly closed. Live steam under pressure is turned into the retort. This heats the contents of the cans to a temperature above the boiling point of water. Various

FIG. 84. Processing canned sardines.

temperatures and times are used in this step; however, it is certain that a temperature of 240 degrees Fahrenheit applied for two hours is sufficient. Further, it leaves a margin for safety. The cans are water cooled after processing (or retorting as it is often called).

The high temperature and time used, sterilizes and thoroughly cooks the sardines. Even the bones are made soft and edible.

The cans are next washed in soap solution and allowed to dry. They are then conducted to a room where they go into temporary storage.

Testing. The cans are allowed to remain in temporary storage for about two weeks. At the end of this period each one is examined and those which were not tightly sealed thrown out. These cans are easily

discovered as they have a distorted appearance. They are called "swells." Such condition is brought about by bacteria which enter and act upon the contents. The other cans are then labeled and packed into cases, ready for shipment anywhere.

Preparation of steamed "pound oval" sardines and of other packs.

Steamed "pound oval" sardines are prepared in a manner quite similar to the fried pack. After brining the fish are packed into the cans without drying. Preliminary cooking is accomplished by inverting the filled cans and steaming them. The inverted position permits drainage of the oil and extractives cooking out of the fish. After steaming the same procedure is followed as after frying. This pack can be made more cheaply than the fried one and many people prefer it, too.

"Quarter oil" sardines are prepared and packed in the same way as the fried "pound oval" pack, except for variations in the procedure necessitated by their small size.

Kippered sardines are prepared by placing the fish in chambers where they are treated with hot smoke. This cooks and smokes the fish in the same operation. They are then packed into the cans with or without sauce, sealed, and processed.

FOOD VALUES.

Sardines, like other fish, are excellent food. One could replace all other meats in one's diet by sardines every day in the year and be just as healthy, because they contain as much body-building material and are as readily digested as their more expensive rivals.

A list is given below of important food products having high protein content. The current price of these articles and the food value per pound of each as purchased are included. The food value of the amount of each article which can be purchased for twenty-five cents is given in the last column.

Comparative Costs and Food Values of Some Common Sources of Protein.[1]

Food	Current price	Food value per pound as purchased	Food value purchased for 25 cents
Sirloin steak	35 cents per pound	675 calories	808 calories
Mutton, leg	3[illegible] cents per pound	890 calories	6[illegible] calories
Ham, fresh	4[illegible] cents per pound	1,320 calories	825 calories
Veal, cutlets	30 cents per pound	745 calories	465 calories
Eggs	50 cents per dozen	6[illegible] calories	423 calories
Milk, whole	14 cents per quart	310 calories	1,107 calories
Cheese, full cream	30 cents per pound	1,885 calories	1,566 calories
Chicken, broiler	60 cents per pound	289 calories	120 calories
Baked beans, canned	15 cents per 11-ounce can	555 calories	678 calories
Halibut, steak	25 cents per pound	475 calories	475 calories
Salmon, canned	25 cents per No. 1 can	915 calories	858 calories
Tuna, canned	35 cents per No. 1 can	960 calories	643 calories
California sardines, "pound oval," 4 to 7 fat fish per can	15 cents per can	938 calories	830 calories
California sardines, "quarter oil"	20 cents per can	1,101 calories	275 calories

[1]From an unpublished table prepared by Mr. L. D. Elliott of the National Canners' Association Laboratory, San Pedro, California.

Examination of the table shows twenty-five cents to have higher purchasing value for cheese and milk than for "pound oval" sardines. For other articles its purchasing power is lower. "Quarter oil" sardines are even higher in food value per pound than "pound oval" sardines, but they are more expensive. Anyway, they are hardly comparable with the other foods listed as they are classed more as a delicacy than as a staple article of food.

In considering food values it is important to realize that canned sardines are especially high in mineral constituents. Few foods have as high edible content of phosphates and lime as they have. For "pound oval" sardines this value is around two per cent.[1]

[1]From analyses made by the author in the Preservation Laboratory, Fish and Game Commission of California, San Pedro.

INSPECTION IN THE SOUTHERN CALIFORNIA FISH CANNERIES.

NORMAN HENDRICKSON, Director, Southern California Fish Investigations, National Canners' Association.

Four years ago in November the fish canners in southern California entered into an agreement with the National Canners Association by which the canners volunteered to submit to a systematic investigation and to abide by rules and regulations to be provided by the association, the cost to be paid by assessment on the cans at the time of purchase. The original contract was for a period of three years. This has expired and a new one has been executed which terminates December 31, 1922. It seems probable that the inspection service will become a permanent institution but that its functions and methods of operation may be varied from time to time to suit the constantly changing business conditions of the industry. Though lacking the authority of a governmental agency, a private institution of this kind is unhampered by direct responsibility to the public and consequent red tape. It can act quickly in any emergency, and need not be as cautious about offering opinions or advice or risking errors in judgment, as is necessary in a public servant. It should be especially serviceable for trying out new projects which are not sufficiently conservative or safe, or which are too closely allied to private enterprise to be undertaken by any public or semi-public agency.

At the time the inspection was established the sardine and tuna industry was growing very rapidly on account of the stimulus given to food production as a war measure. This was responsible for the erection of a considerable number of new canneries and the operation of some of them by men lacking in experience in the canning of sardines and tuna and unfamiliar with the principles involved. The demand for fish was so keen that the fishermen were having things more or less their own way. Prices were advancing and some canners had become rather careless about the quality of fish accepted for canning.

The scope of the inspection in the beginning included a close supervision of the fish from the arrival of the fishing boats until shipment of the final product, and sometimes even further. Every load of fish on arrival at a cannery was carefully examined and passed upon by a competent inspector before acceptance by the buyer. A number of loads were condemned and diverted to reduction plants at a lesser price than would have been paid had they been accepted for canning. This, of course, led to some wrangling and ill-feeling on the part of a few fishermen and inspectors, but the need for such measures was shortlived and all concerned are apparently agreed that they have been benefited by the resultant improvement in the quality of the pack. Excess supplies of fish at any cannery were diverted, whenever possible, to other canneries where there was a shortage, resulting in a considerable saving of food supply.

A close supervision was maintained over the processes involved in the canning, and over the sanitary conditions of the plants, the workers, and the product. A number of invitations have been issued to canners

to clean up certain parts of their plants and equipment. A considerable number of changes in process have also been recommended. Both of the above have been, in all cases, promptly complied with.

A very complete chemical laboratory has been installed and a competent chemist employed. Samples of oils, sauces, and other materials used in sardine and tuna canning are examined before purchase by the canners. A considerable number of instances of adulteration and poor quality in the supplies have been discovered in time to prevent their use by the canners. The time of the chemist, when not employed in testing materials, is devoted to scientific investigation of questions constantly arising relative to canning or the preparation of by-products.

The authority conferred by the United States Food Administration was of very material assistance in enforcing the regulations at the beginning and very extensive use was made of it. Fortunately, before this authority was withdrawn the need for it had entirely disappeared. Both canners and fishermen took very kindly to the regulations as soon as they became familiar with, and accustomed to them.

The most friendly relations with local, state, and federal officials have been enjoyed at all times and have been a wonderful assistance in attaining the desired results without compromising these officials in any way in their official relations.

For two years samples were examined from the daily pack of each canner and certificates issued to such as met the requirements. This issuing of certificates has now been discontinued, partly on account of the expense involved in safeguarding the use of the certificates, partly because the improvement in the pack as a whole makes it less necessary, and partly because there is danger that the issuers of certificates may become partly responsible for the quality of the product. After very careful consideration, all interested are agreed that the responsibility for a product should rest solely upon the manufacturer.

On the whole those in charge of the inspection feel that they have accomplished fairly well the purpose for which the inspection was started. The canneries as a group are quite modern and though there is considerable room for improvement in many of them the state of California has good reason to be proud of them. The quality of the product, the appearance and sanitary condition of the canneries is unquestionably as good as any in the world.

The California sardines of "quarter-oil" size, that is, those packed in olive oil in the familiar small flat tins, lend themselves to the preparation of a very superior article, equal to, if not superior to the best packs of French sardines. The large "pound oval" size packed in various sauces makes an excellent and cheap article of food.

Constant improvements in the handling and packing of the product are being evolved through the enterprise of the canners and the investigations of the various agencies studying the problems of the industry.

NOTES ON THE SEA LIONS.

By Edwin C. Starks.

The sea lion rookery (breeding place) of Ano Nuevo Island seems to be increasing in size, or perhaps it would be better to say, regaining its former size. Whether this is a local or a general increase in number of the sea lions, I have no means of knowing at this time. Neither do I know whether or not this indicates a temporary condition of the rookery; a maximum number, perhaps, of a fluctuation that may have taken place at periods for years without having been commented upon.

An increase of one rookery need not at all indicate an increase among the sea lions in general. It is supposed that the animals always resort to the same rookery, coming back from year to year at the breeding season. If this be so, it would be reasonable to expect a protected

Fig. 85. Ano Nuevo Island rookery, showing cows and pups, Steller's sea lions. Photograph by Edwin C. Starks.

rookery, such as Ano Nuevo is, to increase in size. Certain individuals that bear scars or other marks of identification have been observed to appear at the same rookery year after year.

As further proof of this, and showing what may happen to an unprotected rookery, the conditions of some of the California sea lion rookeries may be cited.* On some of the Santa Barbara Islands several years ago the sea lions, at least the young, were killed for their skins. Sealers landed at the rookeries and clubbed the pups. The most accessible rookeries rapidly grew smaller from year to year, and at last completely ceased to exist as rookeries.

The number of young ('pups') indicate the size of the rookery. Each female ('cow') of breeding age has a single pup each year. Hence

(*Ano Nuevo Island is a rookery of Steller's sea lion.)

each pup on the rookery represents a breeding cow. Each male ('bull') has a 'harem' of from 3 to 18 or 20 cows, or an average, perhaps, of 8 or 10. So by counting the pups on a rookery the size of the rookery may be ascertained with considerable accuracy. This, however, does not take into consideration a more or less indefinite number of individuals not yet breeding ('virgins' and 'bachelors') that are always to be found about the edges of the rookery. But however accurately the number of pups may indicate the entire size of the rookery, they certainly may be used as an accurate index to the fluctuations in size of the rookery. As the pups, until they are a month or six weeks old, do not leave the rookery when the adults are frightened away, they may be counted with considerable ease and exactness.

I spent several days at various times on the Ano Nuevo rookery in the years 1901 and 1902. The rookery was then confined to either one

FIG. 86. Steller's sleeping pups. Adults in the distance. Ano Nuevo Island rookery. Photograph by Edwin C. Starks.

of two outlying rocky islets, known as Flag Rock and Sea Lion Rock, respectively. It was then a rookery of about 150 pups. Stories were current, however, of how in former years the rookery was much larger and not only covered the two outlying rocks, but also a part of the main island.

I recently (June 25, 1921) visited the island and found the latter condition. Both Flag and Sea Lion rocks were occupied and there was a considerable overflow onto the main island. I was informed that the number of pups at the last count (last year) was about 500.

The desirability of thinning out the sea lions is being continually brought up by the fishing interests. Before such a course is thought of, it should be ascertained with great certainty whether the sea lions are increasing or diminishing in number. Even if an increase is found, it should be made certain that it does not indicate a more or less normal fluctuation. If it can be proved that there is a steady increase, the animals may well be kept down to reasonable numbers.

This may most easily be done by killing a predetermined number of the pups on the rookery and carefully watching results. Shooting the

adults from a boat when they are in the water is uncertain, cruel and wasteful. One never knows the percentage of wounded animals, for when shot they usually sink at once. The young nurse for the greater part of the year, so killing a cow usually means the slow starvation of her pup. In killing the pups on the rookeries the skins may be saved.

If nearly any sort of animal were thinned in number, one might naturally suppose that, if there were left a few of each sex of that animal, it would in time increase until it regained its former number. Such does not always appear to be the case. Often when an animal reaches a certain low level in number, it seems unable to recover, but becomes extinct. Hence the question of thinning out the sea lions should be approached with extreme caution. There is an intricate balance maintained between animals that seldom can be disturbed

FIG. 87. Steller's sea lion, after being frightened from the rookery, Ano Nuevo Island. Photograph by Edwin C. Starks.

with impunity. Aside from purely sentimental reasons for wishing to preserve the sea lions on our coast, it may develop in time that they have as much value as many other products of the fisheries.

It may be pointed out in this connection that the cormorants, shearwaters and other sea birds, keep themselves pretty well gorged with fishes. As there are thousands of these birds along the coast, the total number of pounds of fishes per year that they consume must amount to considerable. But no one, I hope, will want to, or be allowed to, kill the sea birds on this account. The leopard seal is surely equally as great a fish eater as the sea lion, as are also the several porpoises. Sharks, too, may well cause much of the damage that the sea lions are blamed for. Lastly, destructive methods and waste in the fisheries may well receive consideration for depleted fisheries.

The sea lions of both species deserve study. A census should be made of the rookeries from year to year. Though the number of pups on the California rookeries indicates the number of sea lions on the coast at the breeding season, it is not at all certain that it indicates the number for all of the year.

Steller's sea lion breeds from the Santa Barbara Islands northward into the Arctic Ocean. The California sea lion breeds from the Santa Barbara Islands southward to some point on the Mexican coast. It is supposed that there is considerable migration among them, but there is no very good direct evidence of this. It may be, for instance, that the animals from Alaska spend a part of the year on the California coast. At any rate it is known that the California sea lion, that does not breed north of the Santa Barbara Islands, migrates at least as far north as the Columbia River.

FIG. 88. Steller's cows and pups on Ano Nuevo Island rookery. Photograph by Edwin C. Starks.

The fur seals, that are rather closely related to the sea lions, breed only in the Arctic Ocean, but they migrate southward along our coast, and have been killed in former years on our mainland, and within my own memory on the Santa Barbara Islands. As the sea lions have many of the habits of the fur seals, we may argue that they, too, migrate from the place they were born. We do not know how far north the California sea lion extends its range, nor how far south Steller's sea lion goes.

Though a census of the California rookeries may not show the number of sea lions that may visit the coast, nevertheless such a record should be kept from year to year if only to show the number born on the coast and to preserve important data for future study of the life history of the animals.

Pups should be marked or branded with a distinctive mark for each rookery, and records made of the subsequent movements of such marked individuals. Thus it may be known whether animals born on one rookery ever breed on other rookeries. By this means, also, the extent of migrations could in time be learned. By a system of marks changing from year to year, the approximate breeding age as well as the entire age could be ascertained.

A DISTRIBUTIONAL NOTE ON HALIOTIS.

By S. Stillman Berry.

In his useful paper on "The Abalones of Northern California," in Volume 6 of this journal, Thompson ('20, pp. 45, 50), while recording the northern green abalone (*Haliotis walallensis* Stearns) from Monterey, a station which a small, rather poor specimen in my own collection apparently confirms, is inclined to reject the Alaskan white abalone (*H. kamtschatkana* Jonas) from the California list. However, a small form of it does undoubtedly occur at least as far south as Monterey Bay. Cooper, who states that he picked up a single dead shell on the beach at Monterey, affirmed this half a century ago ('70, p. 61), while another dead shell dredged by me in 15 fathoms, off Monterey, in 1906, was recorded some years ago (Berry, '07, p. 46) as *H. gigantea*, authorities differing then, as they still do, as to whether *kamtschatkana* and *gigantea* are practically separable. Present reexamination of the specimen does not cause me to alter this opinion of its identity.

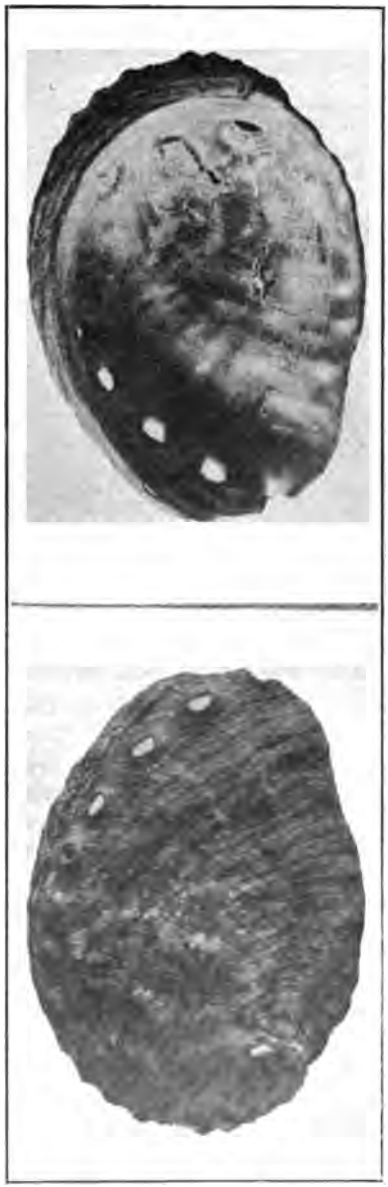


Fig. 89. *Alaskan white abalone (Haliotis kamtschatkana* Jonas), from Monterey Bay, California. Natural size. Photographs by S. S. Berry.

On a recent visit to Monterey, Mr. Carl Dolter showed me a small series of dead abalone shells which he had picked up along the sandy shore just north of Del Monte. All proved to belong to this northern species. One of these, which Mr. Dolter kindly gave me, and which is here figured for the sake of completing the valuable series of illustrations given by Thompson, is practically perfect, and measures, length 61.5, width 44.0, height (est.) 17 mm. None of the specimens is in any way commensurate with the ordinary Alaskan examples. *H. kamtschatkana* is far and away the smallest known species of California abalone.

Other authorities to record the Alaskan white abalone from Monterey have been Carpenter ('64, p. 541) and Campbell ('91, pp. 103, 104). Quite recently Dall ('21, p.

184) has recorded *H. kamtschatkana* from as far south as Redondo, but throughout this paper credence is unfortunately given to many poorly authenticated or doubtful extensions of geographic range, so that even where they seem perfectly reasonable, it would be easy to show too much precipitance in copying them until the supporting data can be placed on record.* Incidentally it may well be mentioned that the taxonomic recognition of no less than twelve Californian abalones in this paper is a little misleading to the general reader, for at least two of the subspecies of *H. cracherodii* there recognized are based upon characters which seem certainly pathologic (*holzneri* Hemphill and *imperforata* Dall), while the other two are likewise of extremely uncertain value racially. Eight distinct forms of *Haliotis* is the only safe maximum we can claim at the present time.

H. kamtschatkana has figured but scantily in the literature of our fauna, and although by no means the rarest, is one of the least known of all our species. By all odds the best available account of it is that of Thompson (:14), which concerns itself mainly with the economic aspects of this mollusk in British Columbia. Over much of the western coast of North America it is the only discovered species of abalone.

*Carpenter's record of the species from "near San Pedro" ('64, p. 541) is equally doubtful, but perhaps can never be certainly confirmed or rejected. His record of it from the Farallone Islands (op. cit., p. 651) is probably safer.

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A SELECTED BIBLIOGRAPHY OF CHEMICAL LITERATURE PERTAINING TO THE FISH INDUSTRY.

By HARRY R. BEARD, Preservation Laboratory, Fish and Game Commission of California, San Pedro, California.

This laboratory's cooperation with the California fishing industry has shown the need of a selected list of recent references for chemists in this industry who have neither the time nor facilities for making an exhaustive search of the literature bearing on their work. The following list was assembled as an endeavor to meet this need and to furnish a foundation for a more complete working bibliography. It is hoped that publication will extend its usefulness. The references cited were selected from a much larger list collected in a search of Chemical Abstracts, U. S. Bureau of Fisheries' publications, reference works and papers on the subject. The attempt was made to cite only a very few articles which appear in standard reference works or which appear in bibliographies given as a part of articles listed here. The publications of the U. S. Bureau of Fisheries have purposely been omitted, except in a few instances. The annual reports of the Commissioner of Fisheries contain a wealth of excellent material, any part of which can now be found easily by consulting the subject index, the title of which is given as the last reference in the list.

Although prepared primarily for technical men, the list will be found to be equally useful to others.

The importance of the foreign references, coupled with the lack of American articles, made their inclusion advisable.

Much credit is due Mr. Harden F. Taylor of the U. S. Bureau of Fisheries, Washington, for his criticisms and additions.

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*The Division of Fishery Products, U. S. Bureau of Fisheries, Washington, issues a series of memoranda on the capture, preservation and utilization of fishery products. These memoranda, copies of which can be obtained upon application, contain a wealth of information. Number S200 of this series gives the titles of the numbers issued to June 1, 1921.

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December 12, 1921.

A SARDINE NUMBER.

mmercial fisheries in California first into prominence in early days with almon industry, which was the first ig industry of any importance in the state. Then developed the tuna industry, and in the last few years the sardine industry has come to be recognized as the most important of the fishing industries. These fisheries mean an annual return to the state of many millions of dollars. The total pack of all varieties of fish canned in 1920 was about 1,941,984 cases. In view of the constantly growing value of these industries, and the part played by the Fish and Game Commission in their development, we are issuing this "Sardine Number." The excellent and well illustrated articles on the sardine industry, methods of catching and of canning, and of the various uses for these fish and their by-products, have been prepared by the staff of the State Fisheries Laboratory, and are designed particularly for those readers who are interested in fisheries in general. Nevertheless, they should prove of value to the trade because of statistics which appear in print for

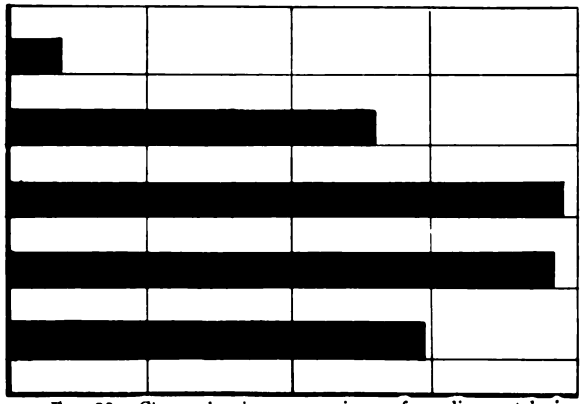

FIG. 90. Chart showing comparison of sardine catch in California, years 1916 to 1920. Prepared by S. H. Dado.

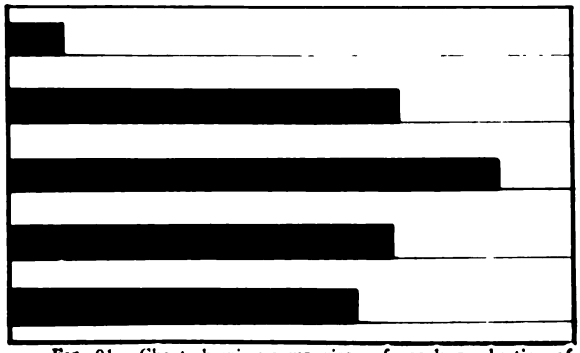

FIG. 91. Chart showing comparison of yearly production of California canned sardines. Prepared by S. H. Dado.

the first time. The accompanying diagrams (Figure 90 and Figure 91) will show the rapid growth of the industry, and the yearly production from 1916 to 1920.

COMPARISON OF SARDINE CATCH.

The United States Bureau of Fisheries has furnished us with a comparison of the output of the sardine fisheries of Maine, Norway, Portugal, and France, together with the relative number and value of the plants, the number of employees, the total quantity of fish caught, and the quantity of sardines caught, the quantity canned, and the value of the sardines. A glance at the following table, covering the year 1919, will show how the output and value of the California industry compares with that of the other countries:

Comparison of the Catch of Sardines for the Year 1919.

	California	Maine	Portugal	France	*Norway
Number of plants	41	[1]52			
Value of plants	$7,708,871	[2]$3,680,248			
Number of employe.s	8,242	5,457			
Quantities of fish, lbs.	202,260,000	[3]123,940,635			
Quantities of sardines, lbs.	153,880,000			[4]16,088	[5]185,515
Quantities canned, cases	2,071,641	2,426,132	[6]39,264		
Value of sardines	$11,813,156	$843,463	[7]21,359,695	[8]37,086	

*Commercial report, November 21, 1919 for 1916.
[1]Sardine plants.
[2]Sardine.
[3]Herring and sardines.
[4]Metric tons (16,718.83 long tons).
[5]Metric tons (182,575.55 long tons) exported.
[6]Tons.
[7]Escudos.
[8]Francs.

SUMMER RESORT EDUCATIONAL WORK, 1921.

Continued along the same lines as last year, the Yosemite Nature Guide Service reports increased interest on the part of the public and improved service rendered visitors to Yosemite National Park. That the Fish and Game Commission, cooperating with the National Park Service, has taken advantage of the opportunity to teach natural history and fish and game conservation to summer vacationists is evidenced by the following figures: Attendance at the 52 illustrated lectures and campfire talks given totaled 31,545. Attendance on the 105 field trips given totaled 2214. All day field trips numbered five. Innumerable questions were answered during the office hours. Increased interest in the field trips offered is reported, the numbers in attendance on several occasions exceeding fifty. Splendid opportunity of bringing home conservation lessons was afforded on the field trips by first hand study of trout, deer, tree squirrels, grouse, mountain quail, and band-tailed pigeons, as well as the common song birds. That this educational campaign will react favorably on the development of a useful sentiment as regards the conservation of natural resources, appears inevitable.

STATE FAIR EXHIBIT, 1921.

The general consensus of opinion by visitors to the State Fair (September 3-11) was that the Fish and Game Commission's exhibit was "the best thing on the grounds." It was so well advertised by enthusiastic visitors that practically everyone entering the gates saw the display. Three years ago the Commission installed a permanent exhibit consisting of a panorama of the Sierra Nevada showing three of the state's hatcheries in miniature and lighted in such a way as to give the changing colors of sunset, night and sunrise. Pleasing additions were made this year in the form of Mount Lassen in eruption and a small electric train that formed a special attraction to the children. The floor space was nearly doubled by the addition of a well arranged exhibit by the Commercial Fisheries Department. The increase in the fishing industry was graphically shown and fishery products of all kinds from abalones to tuna were on display. Equipment for whale fishing and abalone fishing were particularly enjoyed by the crowds, as

FIG. 92. Field study class in Yosemite, 1921. Nature walks are part of the summer resort educational program of the Fish and Game Commission. Photograph by H. C. Bryant.

were also the materials manufactured from kelp. Educational films shown twice daily attracted large crowds also. Through the medium of this exhibit many thousands of people have become intimately acquainted with the work of the California Fish and Game Commission.

HUNTING ACCIDENTS.

With the opening of the deer season came the usual number of hunting accidents. One San Francisco hunter was critically hurt in Trinity County when a companion mistook him for a deer, a professor at Stanford University was seriously wounded near Redding, and another man met death at the hand of his hunting companion near Gilroy under similar circumstances. Several other accidents of the same kind might be cited. There should be less danger in going hunting than in traversing rattlesnake country, and yet it is quite the reverse. It is very doubtful whether one man a year dies from the bite of a rattlesnake, and yet anywhere from five to fifteen hunters lose their lives annually. The only excuse that a hunter has who kills his companion is "carelessness," if that can be considered an excuse. Certainly it is not a satisfactory excuse! The spiked buck and doe law has been found helpful in decreasing hunting accidents. This is the state's contribution. The thing now needed is the following of the "look before you shoot" motto by the individual hunter.

PUBLIC SHOOTING GROUNDS.

The usurpation of most of the best wildfowl shooting grounds by gun clubs has caused increased demand for public shooting grounds. Although the desirability of such public shooting grounds appears to be admitted by both state and federal officials, the first real attempts to secure them have only recently appeared. Included in the New-Anthony bill is provision for the purchase, or rental, and maintenance of marsh and water areas especially suitable for migratory wild fowl, which shall be used as free public

shooting grounds in the open hunting season and safeguarded as breeding and resting places for these birds in the close season; and second, the administration of the migratory bird treaty act in order more adequately to maintain and increase the supply of migratory birds, including not only the ducks, geese, and others classed as game, but the great host of smaller species which are so vitally essential to the agricultural interests of the country through their unceasing war on injurious insects.

The most needed step at present is the conservation and perpetuation of a sufficient number of small inland lakes, as well as inland and coastal swamp and marsh areas, to provide our migratory wild fowl necessary feeding, resting, and breeding places within the United States. Many of them should at the same time be set aside as public shooting grounds. Under proper conditions many lakes, ponds, swamps, and marsh areas will yield a distinctly larger return than would the same areas drained for agricultural purposes.

Louisiana is one of the first states to adopt the broad policy of protecting its citizens against monopolization of the desirable hunting grounds by exclusive clubs. In the setting aside of the Pass-a-l'Outre Public Shooting Grounds, a tract of 60,000 acres at the mouth of the Mississippi River, the first public shooting grounds have been established. Here the sportsman of moderate means can enjoy all the opportunities for wildfowl shooting enjoyed by wealthy members of the exclusive clubs in that region.

UNNATURAL NATURAL HISTORY.

Much of the misinformation which prevails among the general public can be traced to the false reports published in our prominent newspapers. We sometimes read of the attacks of mountain lions upon people passing their haunts; or of the attacks of eagles or other large birds upon children and grown people. These stories, when traced to their source, are usually found to be entirely without foundation of truth. Nevertheless, the prejudice left in the minds of those reading such stories is leading to the destruction of many of our large birds, which are fast disappearing and yet are a relatively harmless species.

For example, our attention was recently called to the following item, which appeared in the *Oakland Tribune* of June 8, 1921:

EAGLE KILLS BOY WHO CLIMBS TREE TO LOOK AT NEST.
(By Associated Press.)

Ventura, Cal., June 8.—Juan Gonzales, 11, was killed by an eagle on a stock ranch twelve miles north of here last Sunday, it was announced in a report received today. The boy climbed a tree to look at the bird's nest and was attacked before he could escape. His skull was punctured in three places by the bird's beak.

After reading this item, Mr. Emerson A. Stoner, of Benicia, California, undertook an investigation of the story, and received the following letter from Mr. Lewis P. Hathaway, the Coroner and Public Administrator of Ventura County:

Ventura, California,
June 10, 1921.

Mr. Emerson A. Stoner,
Box 444, Benicia, California.

Dear Mr. Stoner: Regarding the story of the horrible work of eagles in Ventura County, will say:

On June 1, a Mexican employed on Ranch Sespe between Fillmore and Santa Paula appeared at the office of Dr. Merrill in Santa Paula with his little son who was ill; had been ill for some time. Dr. Merrill informs me that in taking the "history" of the case, he asked the parent or parents if the lad had suffered injury within the past few weeks. They said the only chance he had had of being injured was when he fell from a tree several weeks ago; blackbirds had flapped about his head when he attempted to interfere with their young, and, frightened, he had fallen a short distance.

Dr. Merrill made an effort to locate bruises or breaks, but it was not until he had bathed the lad and shaved his head for the removal of cooties, that he could determine as to outward appearances; he informs me there were NO bruises and NO "holes in the skull," or even in the scalp, or indications that there had been any.

The illness was then diagnosed as "peritonitis," because, the possibility of outward injury eliminated, this seemed the only result that could be arrived at.

The lad died on June 2, and the death certificate was "peritonitis."

All of these statements were corroborated by my deputy at Santa Paula, Mr. E. A. French, who is an undertaker. It had not occurred either to Dr. B. E. Merrill or undertaker E. C. French that there was necessity (?) for a notification

of the coroner until the newspaper at the county seat published the "eagle story."

A Spanish vaquero heard the blackbird end of the yarn, proceeded to imagine the wounds on the head, and the business manager for the vaquero's employer brought the embellished story to Ventura. It needed further embellishment and a willing newspaper reporter did the rest.

Interesting, isn't it?

The yarn was only a yarn.

Yours very truly,

(Signed) LEWIS P. HATHAWAY
Coroner.

MIGRATORY BIRDS IN LATIN AMERICA.

Dr. Alexander Wetmore, who has recently returned from a year's absence in Argentina, Paraguay, and Uruguay, has collected some valuable material regarding the status of the North American migratory birds in the countries which he visited.

Among the migratory birds which Dr. Wetmore found in South America was the barn swallow. Other species noted were shore birds which were observed in the marshy pampas or on the coastal mud flats: "Some were found to winter well north in the Tropics and others to travel as far south as the Straits of Magellan. Among our game birds seen in Argentina and elsewhere were the golden plover and pectoral sandpiper."—*Weekly News Letter*, United States Dept. Agr., August 3, 1921.

One of the objects of Dr. Wetmore's trip was to secure information regarding the possibility of arranging treaties with the South American countries for protecting migratory birds, similar to the Migratory Bird Treaty Act which the United States has with Great Britain. When we consider what the protection of migratory birds has accomplished in North America, as recognized by both scientists and sportsmen, we feel that it would be a splendid attainment if their protection could be further extended to this southern country.

RAINBOW TROUT ACCLIMATIZED IN AUSTRALIA.

As has been stated before in these pages, the rainbow trout has become well established in New Zealand and also in Australia. We present herewith (see Figure 93) some visible proof in the way of a photograph of a catch of rainbows made on the Deepwater River, New

FIG. 93. Catch of Rainbow Trout made on Deepwater River, New South Wales, by Mr. J. S. Bacon. Photograph by J. S. Bacon.

South Wales. Mr. J. S. Bacon, who sends the photograph, states that the fish are doing well and breed successfully.

California's rainbow is now widely distributed over the world from Australia to the Argentine. The golden trout is now in demand and the question is: Shall we let the world have it or keep it a distinctive fish in California?

AUSTRALIA SEEKS INFORMATION ON FISHWAYS.

That Australia is confronting the same problem with reference to migratory fish occasioned by the development of irrigation systems that California successfully solved several years ago, is evidenced by the following letter received from Hon. F. Lewis, Chief Inspector of Fisheries and Game, Melbourne, Australia:

From the frequent perusal of your splendid journal, "California Fish and Game," I note that the provision of fishways or ladders is compulsory in your state. Many large dams and weirs have been erected on our water courses during the last few years with a view to conserving water for irrigation purposes, and this work will probably extend very considerably in the near future.

So far no fishways or passes have been erected on any of these weirs, although many of the streams are stocked with both brown and rainbow trout. In addition there are large numbers of native fish, mostly members of the perch family, in these waters. As it is very desirable to allow facilities for the natural movements of the fish, I shall be grateful if you can let me have full particulars of the law in operation in your state relating to the erection of fishways or ladders. I should also like to have any plans or photographs available of such works.

Are the fish ladders only erected on streams where trout are found, or must they be placed on all waters irrespective of the class of fish contained therein?

Full details regarding legislation, construction and maintenance of fishways have been sent the Australian official.

NEW BIRD LAW PROHIBITS GUIDES FROM MAKING KILL.

A tendency to tighten the restrictions on the hunting of birds and big game is noted in the game laws for 1921, a summary of which, both federal and state, has been compiled by the Biological Survey of the United States Department of Agriculture, and published as Farmers' Bulletin 1235. Among the notable changes made during the present year was the amending of the Migratory Bird Treaty Act regulations with respect to bag limits.

This amendment provides that the daily bag limit of any person shall now include "all birds taken by any other person who for hire accompanies or assists him in taking migratory birds." This will put an end to the abuse of privileges under the regulations regarding the prescribed daily bag limits by persons who claim that birds were killed by guides accompanying them.

The federal waterfowl season for California was fixed from October 1 to January 15, replacing the old season of October 16 to January 31, the season now being the same under both federal and state laws. Regulation 9, governing the issuance of federal scientific permits, was amended to permit the issuance of limited and special permits.

State legislation harmonized federal and state laws on waterfowl and shore birds in Kansas and Oregon, and on waterfowl in Pennsylvania and Rhode Island; Washington prescribed a statewide open season on all migratory game birds from October 1 to January 15, thus deviating from the federal regulations, which supersede the state law, east of the Cascade Mountains, where it will now be possible to hunt migratory game birds only from October 1 to December 31, without violating either federal or state law; in Idaho the open season on migratory game birds has been shortened under state law two weeks by opening October 1, instead of September 16, and extending to December 31.

Idaho, Kansas, Montana, Nebraska, Oregon, and Washington enacted legislation similar to the federal regulation prohibiting hunting from airplanes. Colorado reduced the bag limit on ducks from 20 to 15 a day, while Kansas increased the limit from 20 to 25. In New Jersey reedbirds were protected at all times by being placed in the nongame class. The open season for woodcock was shortened 25 days in Michigan, two weeks in New York, and one month in Vermont. Doves were protected until

1924 in Colorado, and in Kansas an open season on them was provided from September 1 to October 15.

In general, seasons on big game were shortened and hunting further restricted. Buck laws were enacted in Michigan, Montana, Nevada, North Dakota, South Dakota, Vermont, and in Washington east of the Cascades. Maine protected spike bucks and prescribed that one of the two deer allowed in the eight northern counties must be an antlered buck, and provided that in two of the counties only residents may hunt deer during the last two weeks of the open season. Bull moose were protected for five years in Maine.

The summary of the laws contains the provisions relating to seasons, licenses, limits, possession, sale, and export, thereby furnishing the reader a brief and convenient synopsis of the laws of each state, territory, or province of Canada. The migratory bird treaty, the treaty act, and regulations, as well as the Canadian regulations also are appended. Copies of the bulletin, Game Laws for 1921, may be had free upon application to the United States Department of Agriculture, Washington, D. C.

WIRE HALTS BEAVER.

A barbed wire entanglement which will keep beavers from destroying property and constructing dams has been tried out by the state fish and game authorities at the A. M. Kischir ranch in the Shields valley with so much success that it is believed that it will no longer be necessary to grant any considerable number of permits to kill beaver in Montana.—*Billings Gazette*, July 15, 1921, Montana.

A SEA ELEPHANT NEAR SAN CLEMENTE.

The issue of *The Catalina Islander* of September 20, 1921, records the occurrence of a sea elephant between San Clemente and Catalina Islands on September 10, by Captain Hugh MacKay, Mr. Mankowsky and party in the launch Manana. Two interesting photographs are shown.

FACTS OF CURRENT INTEREST.

The Fishcultural Department reports that the past year has been a most successful one. Of trout fry alone there were reared and planted nearly 25,000,000.

An old violator was caught with 28 ducks during the early part of September, by Deputy Carpenter. A stiff jail sentence followed.

The Sacramento office has made several Greeks and other aliens put a higher valuation on citizenship by haling them into court on their failure to produce citizenship papers, although carrying resident hunting and fishing licenses.

The Fish and Game Commission's exhibit at the State Fair, during the first week in September, attracted wide interest. The usual display of golden trout was made, no difficulty being found in keeping these beautiful fish on display.

During the summer more than 31,000 persons heard lectures and campfire talks on wild life and its conservation in Yosemite National Park and more than 2000 availed themselves of the opportunity to go afield under a nature guide.

The kelp industry, which grew to importance during the war, is now a memory, all the plants having closed down.

NOTES FROM THE STATE FISHERIES LABORATORY.

WILL F. THOMPSON, Editor.

THE NEW LABORATORY.

This month, September, sees the practical completion of the new laboratory, regarding which an article appeared in the last issue of this magazine. It promises to exceed all our expectations in beauty and convenience, although not too large for efficiency. It is fully expected that the middle of October will see us installed in our new quarters.

THE ALBACORE SEASON.

The albacore season has been unexpectedly successful, there having been taken, according to recent estimates, nearly eight thousand tons. Considering the lateness of the start, which was due to difficulties over price, the catch has been relatively successful. The season has been characterized by a remarkably late run at the Coronado Islands.

At the present writing considerable numbers of yellow-finned tuna and skipjack have appeared. Also numbers of the smallest year group of albacore have been taken, as was the case last year. But no frigate mackerel, dolphins or other unusual fish have come into the wharf as yet. And above all, the blue-fin tuna have been noteworthy for their absence, where in previous years so many have been taken.

THE LABORATORY STAFF.

During the past three months Mr. Sette and Mr. Holmes have both been at San Pedro, but leave September 26 for Monterey, whence they go to Stanford University on the twenty-ninth for the fall term there.

Dr. Tage Skogsberg has been employed to take Mr. Holmes' place during the coming year. Dr. Skogsberg is a graduate of Upsala University, Sweden, and came to this country in order to pursue his studies on ostracods. After residence for some time at Hopkins Marine Station, at Pacific Grove, he sought permanent employment in this country, rather than to return to Sweden. The Commission was grad to obtain him, as men of his qualifications are hard to obtain.

In the place of Miss Helen Edwards, now Mrs. Bacon, whose marriage was chronicled in the last issue of this magazine, we have been fortunate in securing Miss Frances N. Clark. Miss Clark is a graduate of the Zoology Department of Stanford University and has had much experience in assisting Dr. C. H. Gilbert and others in their work on the salmon. She will have charge of the library work in the new laboratory, as well as assisting Mr. Thompson.

Mr. W. L. Scofield has been stationed at Monterey, as previously, carrying on the sardine investigations there.

Mr. Thompson and Mr. Higgins are at San Pedro in anticipation of the opening of the new laboratory. They attended the meeting of the American Association for the Advancement of Science, with which the Pacific Fisheries Society is affiliated, and Mr. Thompson read a paper on his albacore work.

THE SURF-SMELT, HYPOMESUS.

On June 28, Mr. Thompson visited Halfmoon Bay with Mr. Scofield and Mr. Dado, in order to study the run of the surf-smelt, *Hypomesus*. Unfortunately no smelt ran and inquiry was restricted to conversations with experienced fishermen and observation of the beaches on which they are said to run.

It is clear, however, that there are no grounds as yet for supposing that the species spawns on the beach, or even that it spawns in the surf. It is said to be found at irregular times, and sometimes on one beach, sometimes on another. The fishermen with whom we talked could not foretell in any way when a run would occur, and the fish were supposed to appear any time between April and September. The fact that they were usually taken on a beach with a net did not, of course, prove their absence on rocky shores.

The fishermen said anchovies were sometimes taken the same way, at night.

THE LIBRARY.

The California State Fisheries Laboratory has recently acquired the following complete sets:

Journal of the Marine Biological Association of the United Kingdom.

Report of the Lancashire Sea Fisheries Laboratory of the University of Liverpool.

Report of the Liverpool Marine Biological Committee.

Memoirs of the Liverpool Marine Biological Committee.

Transactions of the Liverpool Biological Society.

Meddelelser fra Kommission for Havundersogelser. Series: Fiskeri, Hydrografi and Plankton.

International Revue der gesamten Hydrobiologie and Hydrographie.

Norsk Fiskeritidende.

The Sea Fisheries. J. Travis Jenkins.

Publications of the Conseil Permament International pour l'Exploration de la Mer.

A NOTEWORTHY BOOK.

The library is recently in receipt of a volume, "The Sea Fisheries," by Dr. J. T. Jenkins. It describes the fisheries of England, their administration, methods and scientific investigations in as comprehensive a manner as possible within a good sized volume. It is carefully compiled, in a scholarly fashion, and the content is not marred by unduly emphasized viewpoints. The fact of depletion is stated with proper emphasis, and without distortion of evidence.

In only one particular does the author disappoint to a serious extent, and that is in his avoidance of critical treatment of research work, particularly other than England.

The book is decidedly necessary to any fisheries library, however limited in

scope, and may be obtained from the author, 16 Walton's Parade, Preston, England, at 24 shillings net, postage 1 shilling.

RARE FISH TAKEN AT SAN PEDRO.

During the past summer a brief inquiry into the usage of common names ot the commercial fishes at San Pedro was started to aid in the proper interpretation of the statistical returns of the fishery. This entailed regular trips to the markets by the members of the laboratory staff and a close scrutiny of all doubtful species. In this way ninety-three separate species in the commercial catch have been recognized and their common names noted. A few of these being rare in this locality are worthy of mention.

Among surf-perches (Embiotocidae), few of which are distinguished by the dealers except as "white-, black-, and blue-perch," were several species of especial interest. *Phanerodon atripes*, which to our knowledge has never been recorded south of Monterey since Eigenmann's specimen from Cortez Bank, was represented in our collection by one specimen. *Rhacochilus toxotes*, said to be rare in this locality, was seen by us rather commonly. *Damalichthys argyrosomus*, though common northward, was found occasionally in June and September.

Of the forty species of rockfish or "rock cod" (*Sebastodes* sp.) taken on the California coast, twenty-eight have appeared in the San Pedro markets during June and July. Only two of these species occurring most commonly have well known common names, the bocaccio (*S. paucispinis*) and the chilipepper (*S. goodei*). Many fishermen distinguish between the different species, using names of their own invention, but there is little uniformity among them. Thus, *S. miniatus*, one of the most abundant species, is often called "red rock cod" and sometimes "salmon grouper," although the latter is also applied to *S. goodei*. *S. levis* is called "Harry Olesen" by some, and *S. chlorostictus* is the "chucklehead." The three small, dark-colored species, *S. atrovirens*, *S. serranoides*, and *S. rastrelliger* are frequently confused with the rock bass and included with them in the markets. All the other species are lumped together as "rock cod," by the fishermen, and this practice is extended by the marketmen to include all the rockfish.

The rarer species encountered during the summer are here listed. Two specimens of *Sebastodes eos* were taken at San Clemente I. in June, and several have since been seen in the markets. This species was reported by Eigenmann in 1892 as abundant at times at San Diego, but it has rarely been seen by naturalists since that time.

Two specimens of *Sebastodes gilli* also were taken in July. The occurrence of this species has not been recorded since the original record by Eigenmann in 1891, and it is known only from the types taken at Point Loma.

A specimen of *Sebastodes introniger*, another rare species, was taken at San Nicolas I. during June in eighty fathoms of water. It is one of the deeper water rockfishes and the few specimens known have been taken in Alaska in from 85 to 350 fathoms, on the coast of Washington, and in southern California waters in depths from 178 to 369 fathoms.

Sebastodes ovalis, another rockfish formerly supposed to be quite rare, has occurred in small numbers in the markets on several occasions during the summer. —E. H. and O. E. S.

REPORTS.

VIOLATIONS OF FISH AND GAME LAWS.
April 1, 1921, to June 30, 1921.

Offense	Number of arrests	Fines imposed
Game.		
Hunting without license	6	$95 00
Ducks (wild)—closed season—possession or hunting	3	25 00
Deer meat—closed season—possession	13	400 00
Deer—closed season—killing	4	160 00
Birds (non-game)—possession	2	75 00
Doe—closed season—killing	2	125 00
Pigeons—closed season—killing or possession	3	50 00
Quail—closed season—possession or killing	3	10 00
Geese (wild)—closed season—possession	3	25 00
Bear—closed season—killing	1	
Beaver hide—possession	1	25 00
Doves—closed season—killing or possession	5	175 00
Brush rabbits—closed season—killing	2	75 00
Cottontail—closed season—possession or killing	2	60 00
Spike buck—killing	1	100 00
Cub bear—taking	1	10 00
Discharging oil in San Francisco Bay	1	200 00
Making false statement on application	1	25 00
Failure to produce license on demand	1	25 00
Total game violations	55	$1,630 00
Fish.		
Angling without license	23	$470 00
Striped bass—undersized, offering for sale underweight, shipping undersized, possession or excess limit	22	580 00
Black bass—closed season—possession, undersized or spearing	11	175 00
Crabs—undersized, possession	5	100 00
Crab meat—detached from shell	1	100 00
Abalones—undersized, possession—closed season	38	1,535 00
Abalones—failure to bring to shore attached to shell	1	25 00
Clams—excess limit—undersized—possession	12	290 00
Trout—excess limit—selling—taking in closed season	8	240 00
Catfish—selling undersized—retaining undersized in live cars	3	60 00
Perch—closed season—possession	2	
Sturgeon—possession	1	20 00
Lobsters—undersized, possession—closed season	3	65 00
Halibut—undersized—selling	1	25 00
Fishing within 250 feet of fishway	7	175 00
Fishing for profit without license	9	100 00
Fishing for profit excess limit	1	25 00
Fish trap, using	1	
Trawl net, using in District 9	2	200 00
Dragging inside three-mile limit	1	100 00
Illegal net in restricted district	4	300 00
Saturday-Sunday fishing	2	40 00
Taking fish without hook or line	1	25 00
Total fish violations	159	$4 65) 00
Grand total fish and game violations	208	$6,810 00

CALIFORNIA FRESH FISHERY PRODUCTS FOR MONTHS OF APRIL, MAY AND JUNE, 1921.

Compiled by Fish and Game Commission, Department of Commercial Fisheries.

Species of fish	Del Norte, Humboldt	Mendocino, Sonoma, Lake	Marin	Solano, Yolo	Sacramento, San Joaquin	Tehama, Colusa, Glenn, Butte	Contra Costa, Alameda	San Francisco, Alameda	Santa Cruz	Monterey	San Luis Obispo, Santa Barbara, Ventura	Los Angeles	Orange	San Diego	Imperial	Total	Mexican, brought into California
Albacore												2,177		667		2,844	
Anchovies								57,420		489,192		6,068		228,764		781,444	
Barracuda											13,815	2,054,474	14,603	650,292		2,733,184	35 355
Bluefish									494	10,678						11,172	
Boccaccio		125						11,942	11,904	193,168						217,139	
Bonito											45	6,323	27	6,718		13,113	555
Carp			67	2,617			9,070	5,904								17,698	
Catfish		3,353		3,751	699		10,005									17,811	
Chilipepper					18,018				883							18,901	
Cultus Cod		1,293						17,301	10,267	22,482						54,552	
Dolphin																	
Eels																	
Flounders	41		56	183			4,519	70,258	10,925	454	996	1,136				88,578	
Grayfish							507	1,500				2,450	250	183,140		187,847	
Greenfish																	
Hake								22,826	488							23,326	
Halibut	11,940	2,132						3,792	538	2,990	108 986	541,365	58,071	179,818		909,572	142 660
Hardhead				32												32	
Herring			4,925								269					5,194	
Kingfish								1,268	14 997	36,057	55	81,258	534	1,081		135,175	426
Mackerel									937	20,117	2,630	449,286	8,507	130,556		612,043	1,953
Marlin																	
Mullet																	
Perch	1,736		8,496				311	8,876	2,094	9,521	18	25,295	679	337		57,394	
Pike				736	122	27	907									1,791	
Pompano									17	138	108	4,549	52	110		4,974	
Rock Bass												51,482	13,193	58,435		123,110	1,796
Sculpin	13,688	2 749	110					55,812	21,312	61,576	17,484	198,274	5,066	112,023		487,672	12,987
Sidefish								62,196	320,213	2 541						445,950	
Salmon	42,681	995,462	407	147,887	221 888	108,489	249,925	127,618	371 758	690 064						3,083,276	
Sandabs								197,814	13,000	2 124		2,380	13			215,340	
Sardines			138					750	100	1,013,484		6,081,198		155,030		7,200,697	
Sunfish												16,668		4,886		28,471	
Sea Bass—Black											578	9,288	868	11,788		22,000	1,769

Shad					48,148			8,765				260	268				
Skipjack																	
Smelt	19,998		3,005				5,156	26,479	11,856	8,689	27,808	28,781	174	3,007		146,901	240
Sole	76							761,762	111,028	22,275	8,251	16,926	598			920,914	
Splittail				46			140									186	
Striped Bass			1,332	30,028		48	76,179	48,961								156,548	
Stingaree														6,795		6,795	
Sucker																	
Surf Fish																	
Swordfish												332				332	
Tomcod								6,490								6,490	
Trout—Farm																	
Trout—Steelhead																	
Tuna												72,157		54,201		126,358	42,991
Tuna—Bluefin												87,128				87,128	50,835
Tuna—Yellowfin												4,205				4,205	5,558
Turbot			73													73	
Whitebait			708					308								1,016	
Whitefish											120	1,848		752		2,720	
Yellowtail												241,918	34	83,484		325,436	7,769
Miscellaneous		1,390					176	5,744	6,109	74,921	3,249	11,725	816			101,030	
Croakers												10,223				10,223	
Total fish	92,715	1,006,205	19,316	335,319	333,574	108,514	998,483	1,532,311	968,895	2,651,424	187,666	10,937,388	106,296	2,014,238		21,292,342	324,279
Crustaceans:																	
Crabs (doz.)	1,388	86	27					5,277	15	1						6,794	
Ecrevisse (doz.)																	
Shrimps								214,232		1,006		25				215,263	
Spiny Lobsters																	318,456
Mollusks:																	
Abalones	3,398		405							409,342	8,212					421,357	
Clams—Cockle	320	415	1,997									83				2,815	
Clams—Mixed	3,070		13,762								46					16,878	
Clams—Pismo											73,637					73,637	
Clams—Softshell	154	4,371	125					13,771								18,421	
Cuttlefish			23					1,899	1,785	9,632		19				13,358	
Limpets																	
Mussels										60						60	
Oysters—Eastern (No.)			621,010							995						621,995	
Oysters—Native			6,540													* 6,540	
Snails																	
Squid										116,398		26,759		86,482		229,639	
Miscellaneous:																	
Frogs (doz.)																	
Terrapins (doz.)		5														5	
Turtles																	1,690
Scallops											735					735	

All amounts shown in pounds unless otherwise specified.

SEIZURES.

Fish and Game and Illegally Used Fishing Apparatus.

Game.			
Ducks	6		
Deer meat	158	lbs.	
Blue cranes 11	90	lbs.	
Rabbits	12		
Pigeons	7		
Geese (wild)	5		
Beaver hides	2		
Doves	6		
Quail	3		
Fish.			
Striped bass	1420	lbs.	
Striped bass	12		
Black bass	4	lbs.	
Black bass	4		
Clams (Pismo)	1871		
Clams (cockle)	25½	lbs.	
Lobsters	19		
Lobsters	91½	lbs.	
Sole	18	lbs.	
Crabs	295		
Crab meat	8	lbs.	
Abalones	232		
Abalones (black)	15		
Trout	413		
Trout	2½	lbs.	
Perch	4	lbs.	
Catfish	35	lbs.	
Barracuda	2720	lbs.	
Halibut	369	lbs.	
Sturgeon	18	lbs.	
Shad	1		
Carp	1		
Illegal nets	3		

FISH AND GAME COMMISSION.

Statement of Expenditures for the Period from July 1, 1920, to June 30, 1921.

Administration:		
Commissioners	$1,115 40	
Executive offices	26,442 43	
Printing	3,073 63	
Research and publicity	6,073 62	
Accident and death claims	1,764 69	
		$42,469 77
Commercial fish culture and conservation:		
Superintendence	$15,781 18	
Inspection and patrol	31,488 15	
Research	31,257 88	
Statistics	10,269 64	
Market fishermen's license commissions	595 50	
Propagation and distribution of salmon	26,164 92	
		115,447 27
Sporting fish culture and conservation:		
Superintendence	$15,068 43	
Printing	299 54	
Prosecutions and allowances	496 15	
Angling license commissions	16,879 50	
Fish exhibits	4,323 19	
General patrol (pro rata share)—		
San Francisco District (40 per cent)	39,296 85	
Los Angeles District (40 per cent)	16 981 60	
Sacramento District (40 per cent)	28,774 32	
Propagation and distribution of trout	150,405 57	
		272,515 15
Game conservation:		
Printing	$461 13	
Prosecutions and allowances	1,057 45	
Hunting license commissions	24,605 60	
Mountain lion hunting (and bounties)	8,630 98	
General patrol (pro rata share)—		
San Francisco District (60 per cent)	58,713 23	
Los Angeles District (60 per cent)	25,370 87	
Sacramento District (60 per cent)	43,158 88	
		161,856 08
Tahoe camping ground		691 04
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CALIFORNIA FISH AND GAME

"CONSERVATION OF WILD LIFE THROUGH EDUCATION"

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CALIFORNIA'S GAME REFUGES.

By Harold C. Bryant.

Each state, as it has seen its game decrease in spite of protective legislation, has sought for some additional means of conservation which would improve conditions. A fundamental law of business is to the effect that although we spend, we must not waste our capital. This is as true of wild life as it is of money. Present conditions show that we have lavishly spent not only the income, represented in annual increase of our game, but have also drawn largely upon our capital, represented in breeding stock. To invest our remaining capital in such a manner as to provide a sure income, has become the most important problem in wild life conservation. Although we may have heard this simile until it seems almost trite, yet it accurately describes present conditions.

In recent years it has become apparent that the very best means of safeguarding our capital of breeding stock is not to be found in season and bag limit laws, but in the establishment of game sanctuaries where wild life is allowed to breed unmolested, and where in time it increases, spreading out to neighboring territory and furnishing food and sport for all those who care to seek it.

Two outstanding factors involving the decrease of game have combined to make the establishment of refuges urgent. In the first place, settle-

ment has reclaimed many of the natural breeding grounds of game with a consequent destruction of food supply. Secondly, in many places in California the country is becoming thickly populated, with a consequent concentration of hunting in nearby localities. The use of the mountains by city people is being continually encouraged and is growing. These factors make it increasingly difficult for game to maintain itself.

The game refuge furnishes an area where game may find natural and safe breeding and feeding grounds in order to insure a sufficient number being left to prevent extermination and, if possible, to keep neighboring territory sufficiently stocked to allow of good hunting.

With the rapid settlement of the country it will soon be impossible to find areas where natural conditions exist. Sportsmen of the future will be forced to do their hunting on artificially planted private grounds, or kill game reared on game farms, unless certain areas are maintained in their natural state. Herein we find an important reason for the establishment of national parks and state game refuges. Not only will the sportsmen benefit thereby, but also the scientists interested in natural history, for the parks and refuges will soon be the only areas unspoiled for scientific study.

That California has done something more than talk about the value of game refuges, is evidenced by the fact that twenty-eight refuges, comprising over two million acres of land, have been set aside by the state. The total area on which animal life is given absolute protection comprises nearly three million acres, for the state is fortunate in having within its borders three federal bird reservations, three national parks and three national monuments, in all of which wild life receives complete protection.

HISTORY.

Even before there were bag limits or seasons on game, the state legislature was convinced of the necessity of giving waterfowl careful protection on a lake in the city of Oakland. In 1869 an act restricting fishing and hunting in and about Lake Merritt, Alameda County, became a law. The thousands of ducks which gather on this lake every winter attest the efficacy of the refuge. Eleven species of ducks regularly resort to the lake in winter, with the pintail, baldpate, canvasback, and ruddy predominating. In fact, the waterfowl have become such a great attraction to both citizens and tourists that the city finds it worth while to furnish grain to feed the birds.

State game preserves.

Sentiment favoring this means of conservation became crystalized in 1907, when an act providing for the establishment of state game preserves became law. The law provides that

> "Any person, firm or corporation, owning and in possession of patented lands in the State of California, embracing an area of not less than one hundred and sixty acres, may transfer, by an instrument in writing, duly acknowledged before an officer authorized under the laws of this state to take acknowledgments, to the State of California, the right to preserve and protect all wild game on the land described therein for a period of not less than five years."

In 1913 a change was made in this law, which made it more effective, the time limit being extended to cover a period of ten years instead of five. Advantage has been taken of this law in only a few instances. At present there are but three state game preserves. One is situated on the land of Mr. Bryan in Monterey and San Benito counties, and the other two are located near each other in Santa Barbara County. Too often applicants attempting to make use of the law show a desire to preserve areas for selfish gain, and not for the benefit of the game itself.

Big game refuges.

Unfortunately no additional refuges were created until 1909, when the Pinnacles National Monument, situated in San Benito and Monterey counties, was made a game refuge.

FIG. 1. A few of the wild ducks on Lake Merritt, a game refuge created in 1869. The city of Oakland feeds these winter visitors to add attractiveness to the city park. Photograph by H. C. Bryant, January 6, 1919.

A large area within the Cleveland National Forest in southern California was made a refuge in 1913. In 1915 there was added an area in the California Redwood Park, in Santa Cruz County, commonly known as the Big Basin, a portion of the Trinity National Forest, in Trinity County, and a large part of the Angeles National Forest, in Los Angeles and San Bernardino counties, the Trinity refuge comprising 64,000 acres and the Angeles 600,740 acres. Both refuges have been increased in size since their creation. In the same year the areas covered by the Trinity and Los Angeles forests were included in the Districting Act, so that legally these refuges are known as fish and game districts. A special law prohibits hunting within the fish and game districts specified as game refuges.

In 1917 the legislature set aside sixteen large areas within the national forests as game refuges. These refuges, scattered from Siskiyou to San Diego County, are as follows:

1A—Siskiyou
2A—Mendocino and Lake
1B—Modoc
1C—Modoc
3C—Santa Barbara
3D—Ventura
4D—Riverside
1E—Shasta
4E—San Diego
1F—Lassen
1G—Tehama
1H—Plumas
1I—El Dorado
1J—Amador
1K—Fresno
1L—Tulare and Kern
Mount Tamalpais—Marin

The selection of the refuges was made possible through the cooperation of the United States Forest Service.

The situations were chosen with reference to the kinds of game to be found; whether both summer and winter range was furnished; the food supply, and the ease of administration. Particular attention was given the boundaries, the attempt being made to use natural boundaries such as ridges and creeks rather than artificial section and township lines recognized with difficulty by the hunter. The legislators were unanimous in carrying out the recommendations.

Three additional areas were created by the 1919 legislature, and one by the 1921 legislature.

Up to the present time, therefore, the state has set aside twenty-eight game refuges and three game preserves, comprising nearly two million acres. These are so situated that they form a chain of refuges, properly spaced, extending from the Oregon line to the Mexican border.

It has been surprising to see how quickly sentiment has come to favor the refuges established. One would have thought that a great deal of complaint would have emanated from hunters when such large areas were selected in some of the best hunting grounds of the state in 1917. The fact is that many who did not favor the refuges when first created now are enthusiastic supporters of the policy. The value of the refuge has been demonstrated to the most sceptical.

FEDERAL BIRD RESERVATIONS.

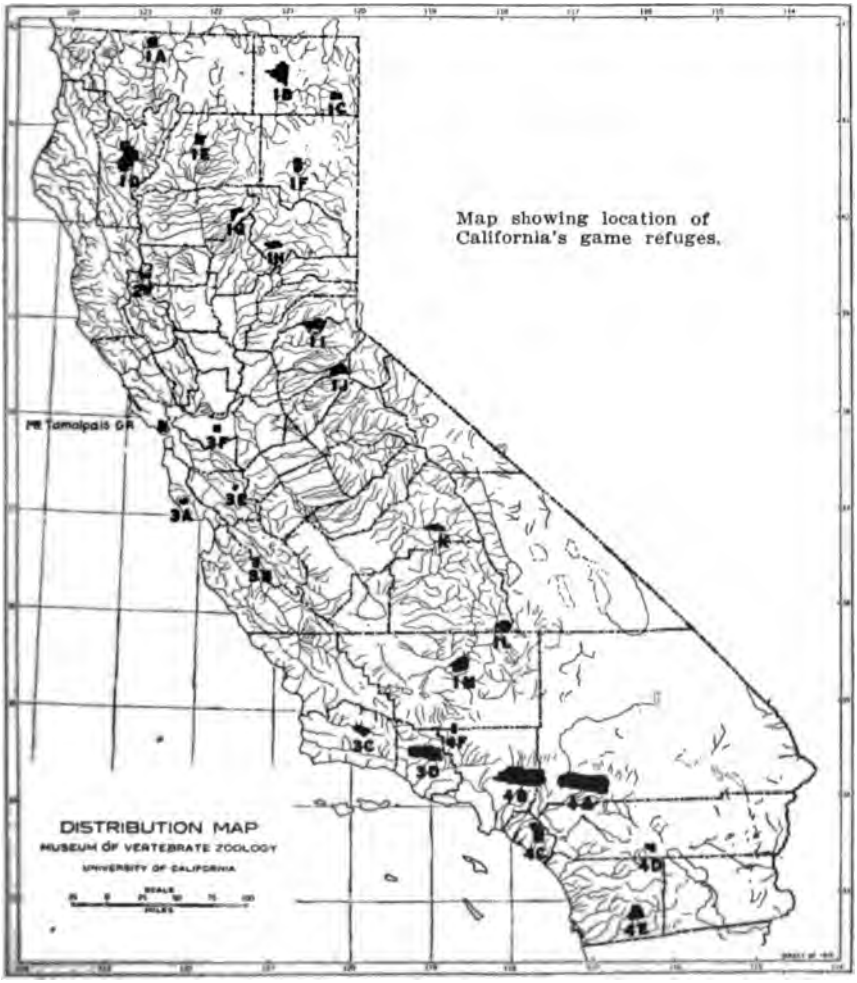
Beginning with the presidency of Theodore Roosevelt, considerable interest was taken in the setting aside of notable breeding areas of waterfowl. The Klamath Lake Reservation was created in 1908; East Park and the Farallon Island Reservation in 1911, and the Goat Island Reservation in 1916.

Unfortunately, conditions in the best of these reservations, the Klamath Lake Reservation, are far from satisfactory. As a result of continued endeavor on the part of land promoters, Lower Klamath Lake is being drained, leaving large areas of alkali and mud flats which neither benefit the settlers adjoining the lake nor furnish additional land suitable for agriculture. Drainage has allowed the starting of large tule fires which, in addition to the lack of water, has rendered large areas unfit for occupation by birds. Unless a change in policy is made in the near future, this valuable reservation for wildfowl is seriously jeopardized. The Farallon Island Reservation forms a splendid sanctuary for murres and other sea birds.

The East Park Reservation proved to be of little consequence in that there was not a suitable food supply attractive to wild fowl on the East Park Reservoir. Investigation having shown that this reservation, and also the San Francisco Bay Reservation on Goat Island, which was mainly useful for the preservation of pheasants planted on the island, were comparatively little visited by wild fowl, an elimination of these reservations was recommended and the President eliminated them by an executive order dated May 20, 1921.

NATIONAL PARKS AND MONUMENTS.

California is fortunate in having within its borders three national parks and three national monuments, which add nearly a million acres to the state's reservations. As all wild life within these areas is absolutely protected, the national parks and monuments constitute some of our best refuges. The large size of the parks in particular, and their advantageous situation, make them especially adapted for the conservation of big game. A visit to any of these parks will demonstrate the usefulness of the policy of protecting all wild life found within their borders.



CALIFORNIA'S GAME SANCTUARIES.

CALIFORNIA IS ASSURING A PERPETUAL SUPPLY OF GAME BY SETTING ASIDE AREAS WHERE NO HUNTING IS ALLOWED AND WHERE GAME IS ALLOWED TO BREED UNMOLESTED. THE STATE IS RESPONSIBLE FOR THE CREATION OF MOST OF THEM, THE FEDERAL GOVERNMENT FOR OTHERS. CERTAIN AREAS KNOWN AS GAME REFUGES HAVE BEEN SET ASIDE BY LEGISLATIVE ENACTMENT. OTHERS KNOWN AS STATE GAME PRESERVES HAVE BEEN CREATED BY THE FISH AND GAME COMMISSION AFTER THE OWNER OF THE PROPERTY HAS CEDED ALL HUNTING PRIVILEGES TO THE STATE FOR A PERIOD OF NOT LESS THAN TEN YEARS. THE FEDERAL GOVERNMENT HAS SET ASIDE THREE BIRD RESERVATIONS AND PROTECTS ALL OF THE WILD LIFE WITHIN THE NATIONAL PARKS AND NATIONAL MONUMENTS. AS A CONSEQUENCE GAME IS NOW ABSOLUTELY PROTECTED ON NEARLY 3,000,000 ACRES WITHIN THE STATE OF CALIFORNIA, AN AREA ROUGHLY EQUIVALENT TO THREE PER CENT OF THE TOTAL AREA OF THE STATE.

GAME REFUGES.

Name	County	Area, acres	Established
1A	Siskiyou	22,540	1917
1B	Modoc	83,060	1917
1C	Modoc	21,760	1917
1D	Trinity	82,560	1915
1E	Shasta	37,760	1917
1F	Lassen	46,720	1917
1G	Tehama	33,920	1917
1H	Plumas	37,760	1917
1I	El Dorado, Calaveras	67,840	1917
1J	Amador	58,320	1917
1K	Fresno	34,240	1917
1L	Tulare and Kern	35,520	1917
1M	Kern	81,920	1919
2A	Mendocino, Lake and Butte	35,200	1917
3A	Santa Cruz	4,480	1915
3B	San Benito and Monterey	14,080	1909
3C	Santa Barbara	41,600	1917
3D	Ventura	125,760	1917
3E	Santa Clara	3,600	1919
3F	Contra Costa	10,240	1921
4A	Los Angeles	293,120	1915
4B	Los Angeles	325,120	1915
4C	Orange	99,840	1913
4D	Riverside	69,120	1917
4E	San Diego	51,840	1917
4F	Los Angeles and Kern	46,080	1919
Mount Tamalpais	Marin	28,000	1917
Lake Merritt	Alameda County (Oakland)		1869
		1,792,000	

STATE GAME PRESERVES.

No. 5	Monterey and San Benito	8,570	1916
No. 6	Santa Barbara	42,000	1918
No. 7	Santa Barbara		
		50,570	

FEDERAL BIRD RESERVATIONS.

Klamath Lake	Siskiyou	*22,400	1908
Clear Lake	Modoc	*1,600	1911
Farallon Islands	Pacific Ocean, near San Francisco		1909
		24,000	

*Approximate.

NATIONAL PARKS AND MONUMENTS.

Parks—			
Yosemite	Tuolumne and Mariposa	719,622	1890
Sequoia	Tulare	161,597	1890
General Grant	Fresno and Tulare	2,536	1890
Monuments—			
Lassen Volcanic	Shasta, Lassen, Plumas and Tehama	79,561	1916
Muir Woods	Marin	295	1908
*Pinnacles	San Benito	2,080	1908
		967,691	
		2,834,261	

*Included in State Game Refuge No. 3B.

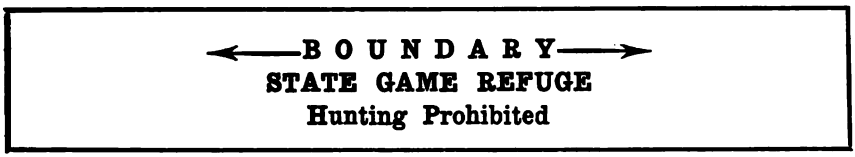


FIG. 2. Type of notice, printed on tin, used to mark the boundaries of game refuges.

ADMINISTRATION.

Care is being taken to administer the game refuges in such a way as to make them most useful. Boundary notices often have been posted as well as cloth signs, warning the public that they are within a refuge.

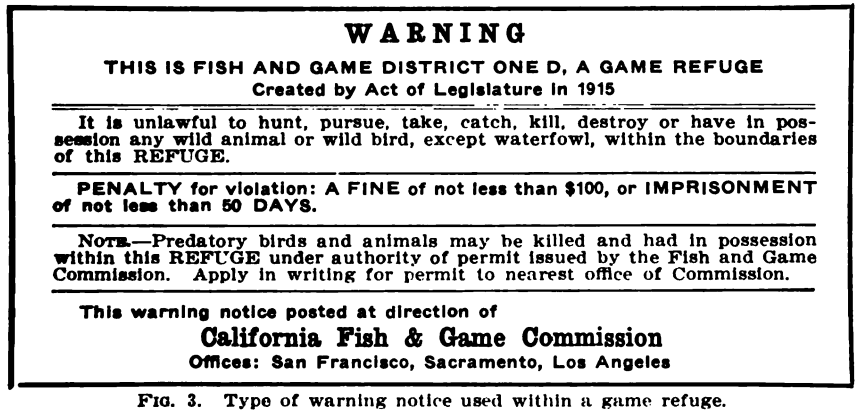

WARNING
THIS IS FISH AND GAME DISTRICT ONE D, A GAME REFUGE
Created by Act of Legislature in 1915
It is unlawful to hunt, pursue, take, catch, kill, destroy or have in possession any wild animal or wild bird, except waterfowl, within the boundaries of this REFUGE.
PENALTY for violation: A FINE of not less than $100, or IMPRISONMENT of not less than 50 DAYS.
NOTE.—Predatory birds and animals may be killed and had in possession within this REFUGE under authority of permit issued by the Fish and Game Commission. Apply in writing for permit to nearest office of Commission.
This warning notice posted at direction of
California Fish & Game Commission
Offices: San Francisco, Sacramento, Los Angeles

FIG. 3. Type of warning notice used within a game refuge.

FIG. 4. Jay Bruce, state mountain lion hunter, with lion killed on the North Fork of the Stanislaus River, on March 27, 1921. His famous lion dog, Ell, occupies the front seat. A large proportion of the lions killed each year by Mr. Bruce are taken within game refuges. Photograph by W. J. Rodgers.

In several cases wardens have been located near refuges in order that they might be well patrolled and in other instances part-time men have been stationed within refuges during the open season to prevent poaching. Augmented patrol in the refuges is planned.

The control of predatory animals within a refuge is largely accomplished by issuing special permits to hunters and trappers making application. In addition, a state mountain lion hunter is retained whose duty it is to go from one refuge to another with his well trained dogs and reduce the numbers of wildcats and mountain lions. (See Fig. 4.) In 1920 Mr. Bruce secured thirty lions, a large percentage of which were killed within the boundaries of refuges. Five refuges and two national parks have thus far received a visit from Mr. Bruce and his lion dogs.

The greatest need now is the careful patrol of the present refuges and an effort to gain maximum efficiency; also the setting aside of refuges for the small herds of elk and antelope still found in the state. The herd of elk in Kern County will continue to be a problem because of their depredations until given a fenced refuge. The area to the south of Lower Klamath Lake, where the largest band of prong-horned antelope is found, should constitute a game refuge.

Another important consideration is whether or not increased opportunity should be afforded the recreationist within game refuges. At first thought it would appear that the game would benefit most by the lack of intrusion on the part of the vacationist, but there is another side. The efficiency of the game refuge is largely dependent upon the

FIG. 5. Flashlight photograph of deer at salt log in Lassen National Forest. Salt for deer is provided in some of the game refuges. Photograph by courtesy of Forest Service.

public sentment of neighboring communities, and this is dependent in turn upon the knowledge and interest of the individuals. Public interest is a necessity and for this reason the legitimate use of the refuge for recreation purposes will in the end benefit game conservation.

MAPS.

In order to acquaint the public with the state's refuges, their extent and boundaries, short descriptions accompanied by a series of maps prepared by Mr. J. S. Hunter, and which are published for the first time, follow. By use of these maps hunters will be able to plan their hunting trips so as to avoid trespassing within a refuge, and conservationists will be able to visualize the extent and topography of the various restricted areas.

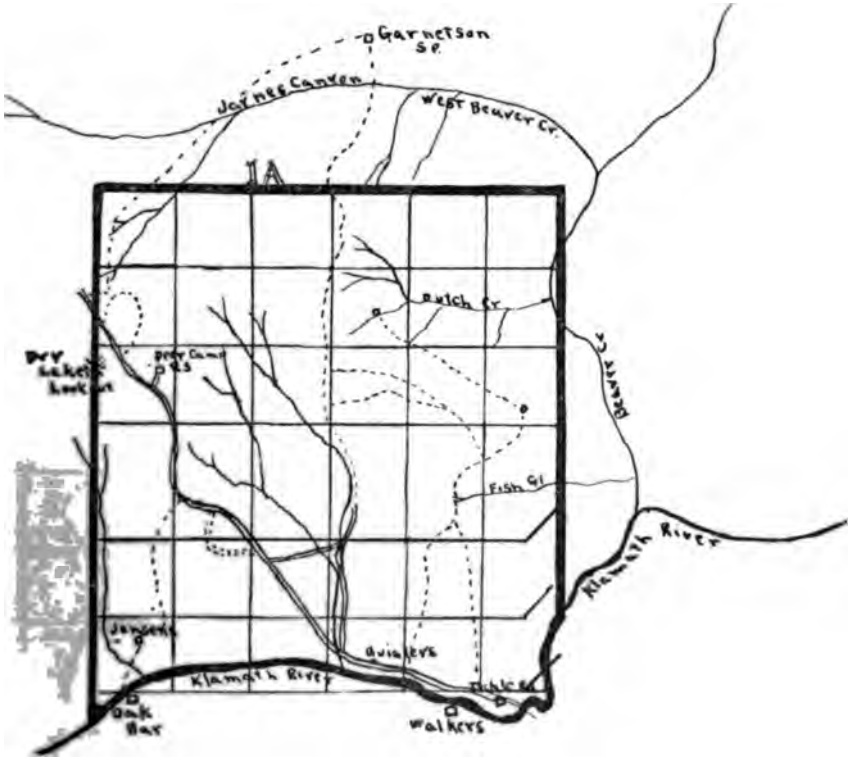


Fig. 6. Game Refuge 1A, situated in Siskiyou County, contains a large number of deer, furnishing summer range in the high mountains, and winter range in the low foothill section near the Klamath River. Nearly every type of forest and brush is represented. A fair salt lick is located near the center of the area. In addition to deer, there is an abundance of grouse, and both valley and mountain quail. Does breed to a certain extent in the lower portion of the refuge. Located in the very heart of the county that is heavily hunted in the hunting season, the refuge furnishes a much needed protection for a large number of deer.

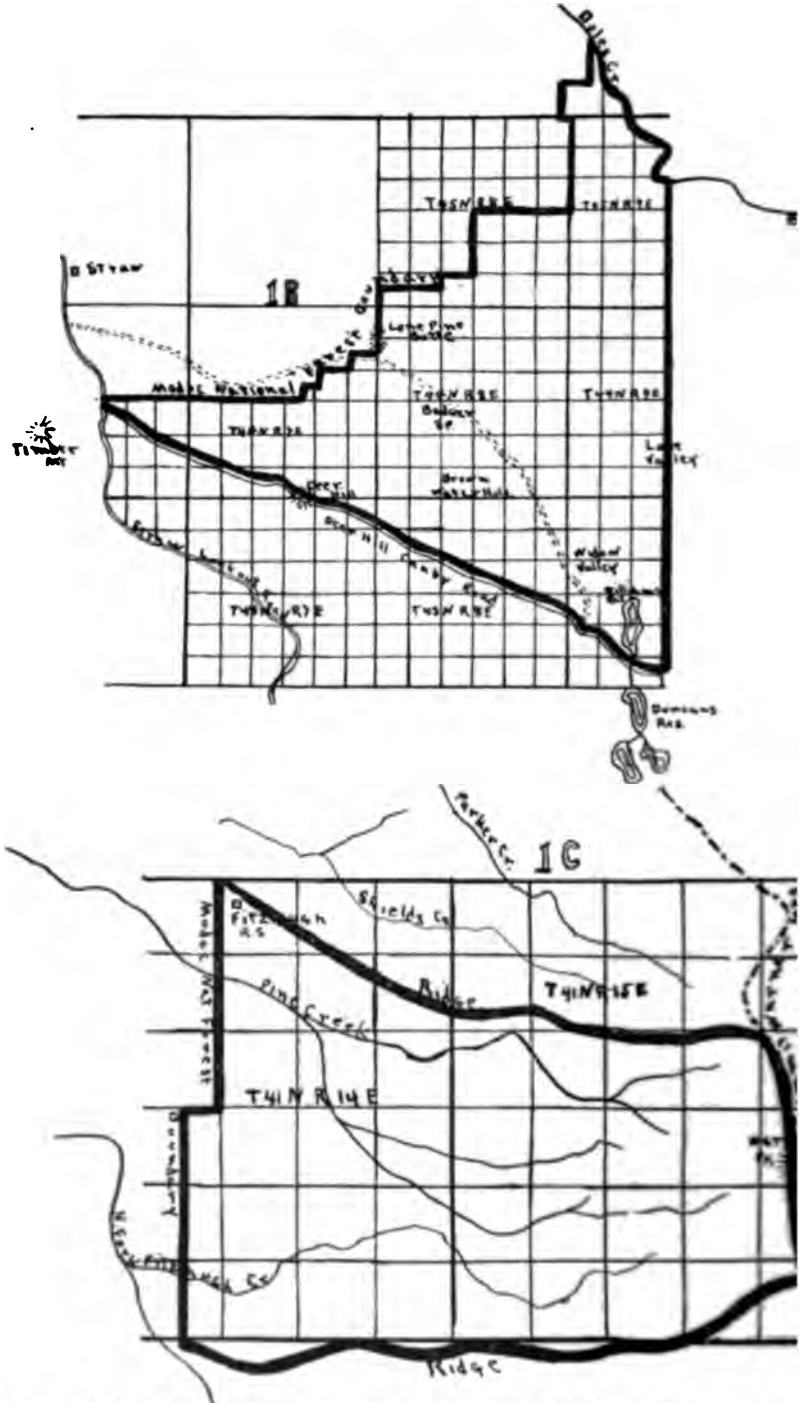


FIG. 7. Refuge No. 1B and 1C were set aside primarily to protect the mule deer. ... cover is mostly a pure stand of yellow pine with some open flats of juniper ... low regions are covered with brush. Mowitz Butte, situated in 1B, is ... quented by mule deer, affording both a breeding place and wintering area. ... 1C, comprising the headwaters of Pine Creek, in addition to furnishing ... the mule deer, affords protection to grouse and quail. No better ... Warner Mountains could have been selected than this area.

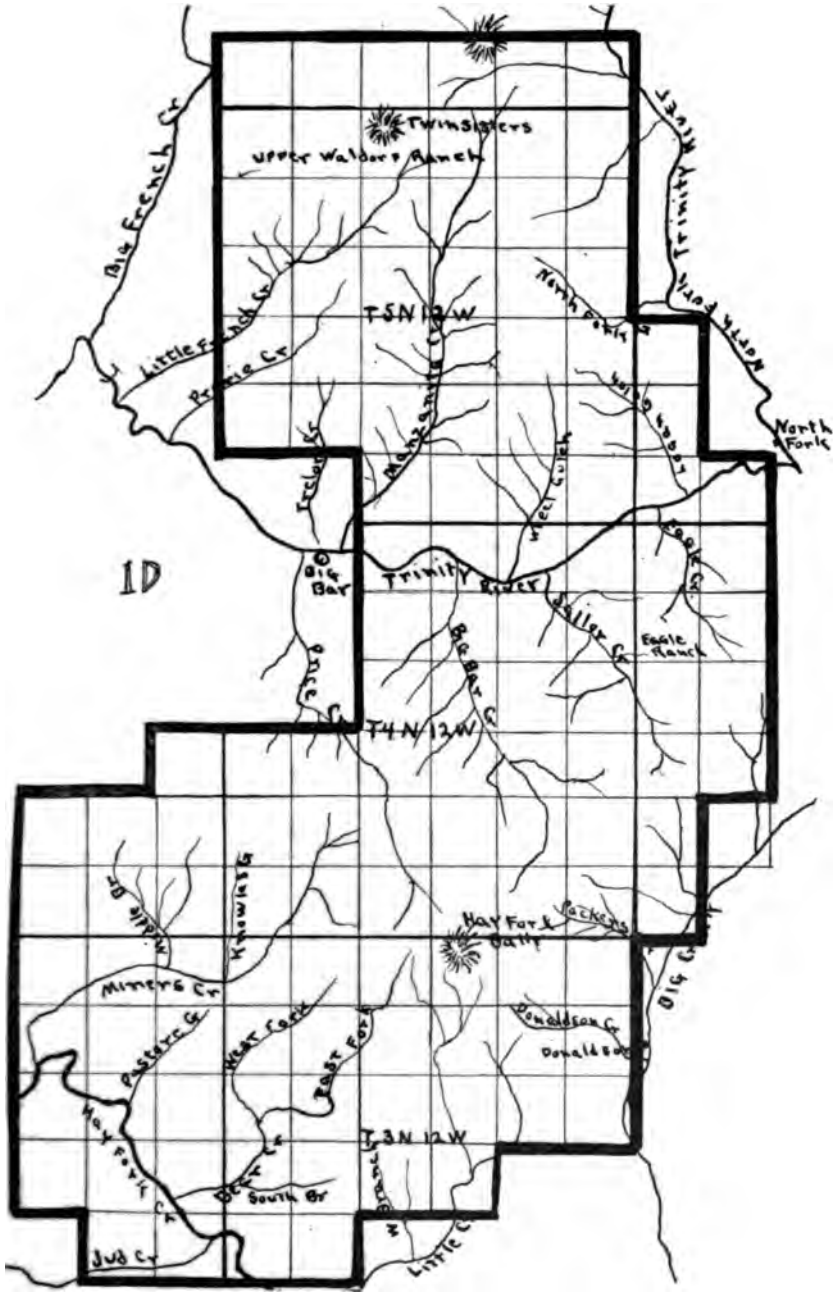


FIG. 8. Fish and Game District 1D, in Trinity County, has proved to be one of the best of the big game refuges. Perhaps its efficiency is simply more apparent because of the length of time since its establishment in 1915. Every resident of the region maintains that deer have greatly increased within the refuge. Certainly ideal conditions exist, there being wide range in elevation and many south exposures, furnishing abundant winter and summer range, so that game need not leave the refuge at any time. There are few places in the state where so many deer can be seen at close range. One adverse factor is becoming more and more important. Considerable grazing is allowed within the refuge and much food that would otherwise be available for deer is eaten by cattle, thus minimizing the population of deer which the area should support. Local sentiment in regard to this refuge has grown remarkably since changing from general disapproval of the restriction to a most favorable and enthusiastic attitude of cooperation.

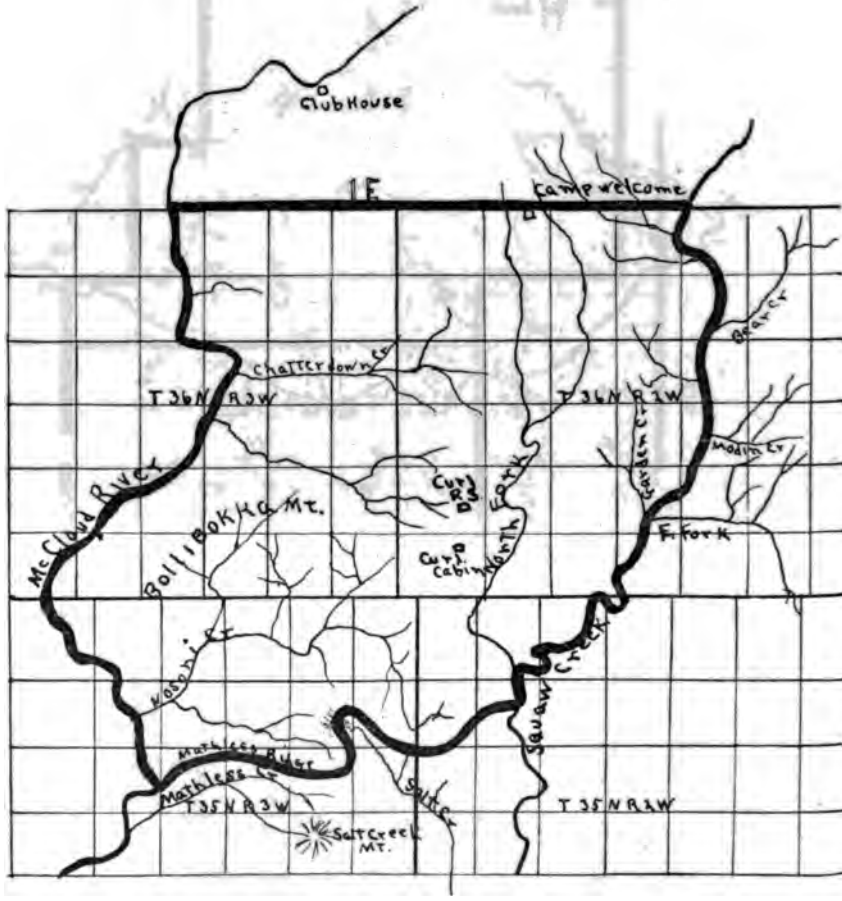


FIG. 9. Fish and Game District 1E, situated between Squaw Creek and the McCloud River in Shasta County, lies in the heart of some of the best hunting grounds in northern California. Year-round range is furnished big game, and both quail and grouse are abundant. A few bear are also found. Several natural salt licks make the area attractive to deer.

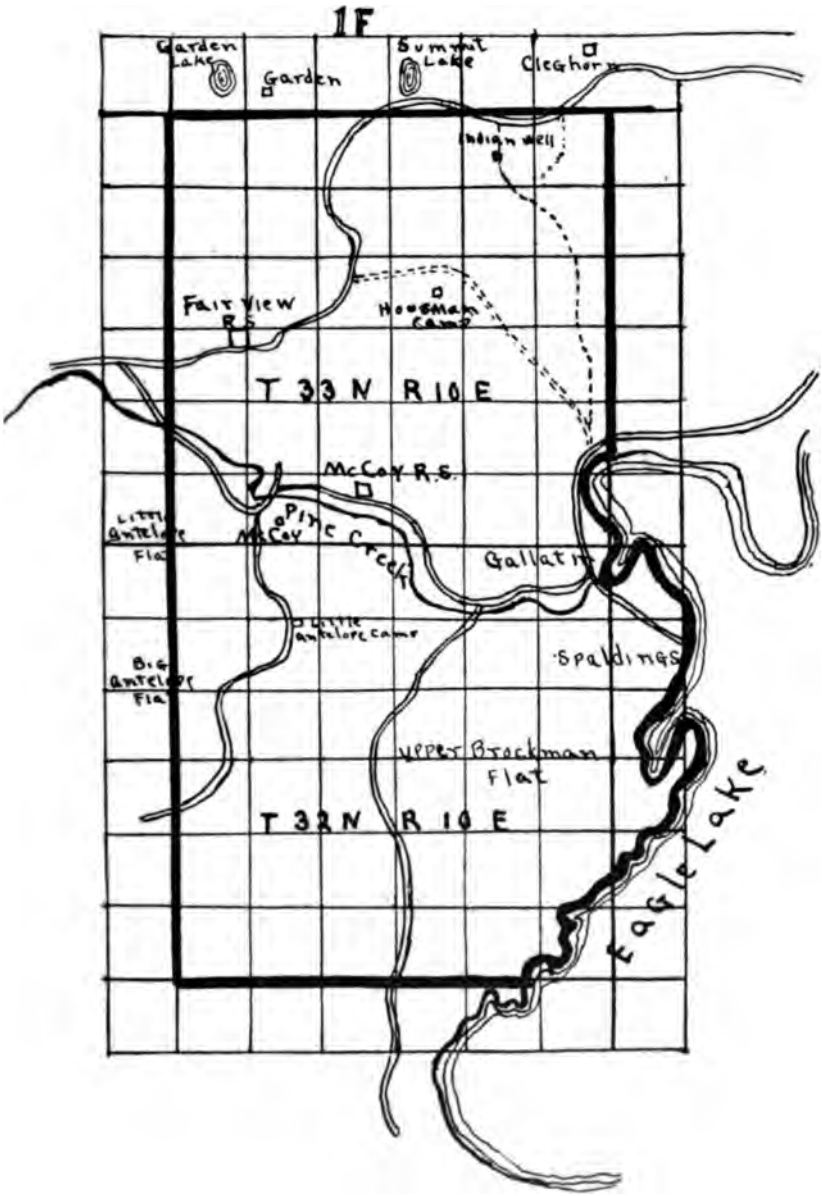


Fig. 10. Fish and Game District 1F, situated in Lassen County, embraces an area ranging from 4800 feet along the eastern edge to 6500 feet on the higher points. There are numerous meadows and also extensive areas covered with brush and with forest. When the refuge was formed it was estimated that 600 mule deer winter within the area. The outstanding feature of this refuge is that a few antelope remain within its borders. Although wholly protected by law, any advantage that can be given to this species should be provided, for few individuals are left of the numerous herds once found within the state. The fact that a few of these animals are within a game refuge should help prevent poaching which goes on in outlying districts. In that this refuge lies for the most part at such high altitude, it does not offer so much good winter range as do many other refuges.

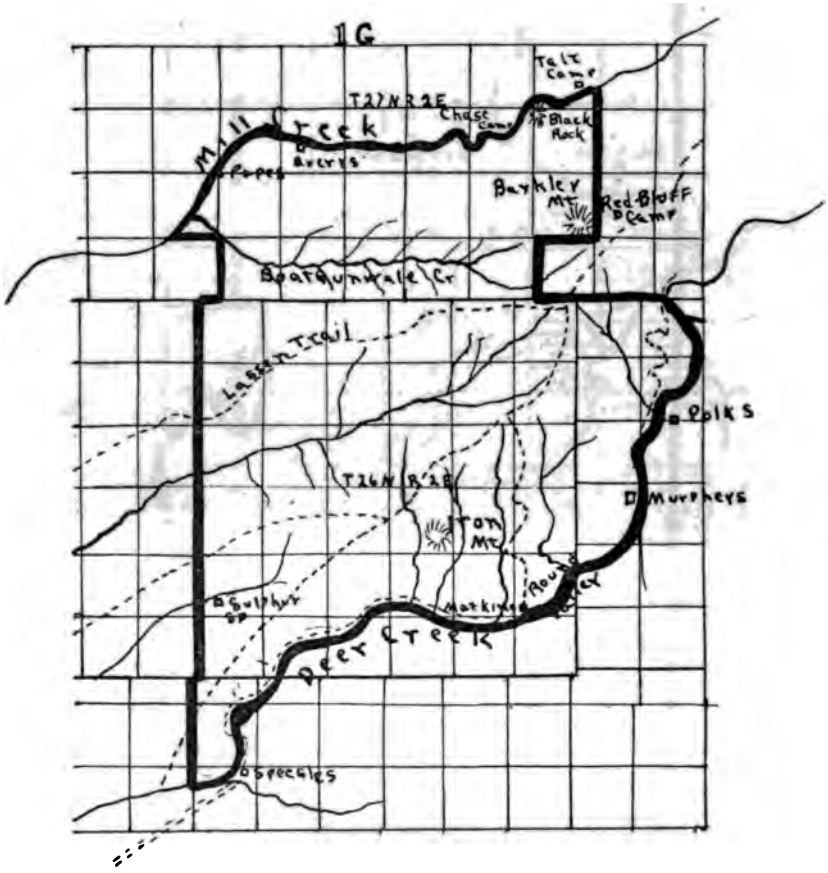


FIG. 11. Fish and Game District 1G, embracing a rough area between Mill Creek and Deer Creek in Tehama County, furnishes both summer and winter range for black tail deer, bears, and such upland game birds as grouse, mountain quail and valley quail. Deer concentrate in the western portion of the area in winter and spread out over the eastern part in summer. The forests covering the larger part of the refuge are white oak, digger pine, and brush on the winter ranges, and yellow pine, sugar pine, fir and cedar on the summer ranges. The winter range has excellent forage and is rarely completely snowed in.

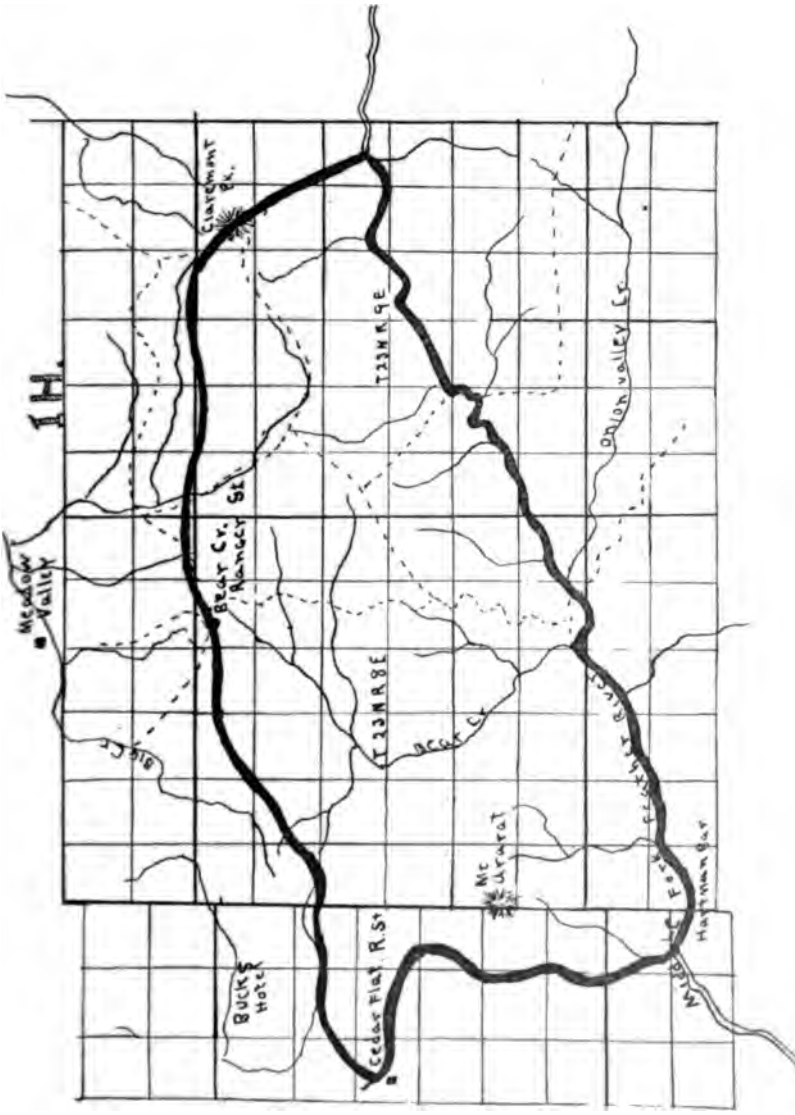


FIG. 12. Fish and Game District IH comprises an area on Mill Creek in Plumas County, ranging in altitude from 1600 feet on the west, to 7831 feet on Butte Mountain to the east, and offering both winter and summer range for big game. The western portion of the area forms a great winter resort for deer, both grass and browse being abundant; the eastern part furnishes a splendid summer range and deer are found in large numbers, as are mountain quail, valley quail and grouse.

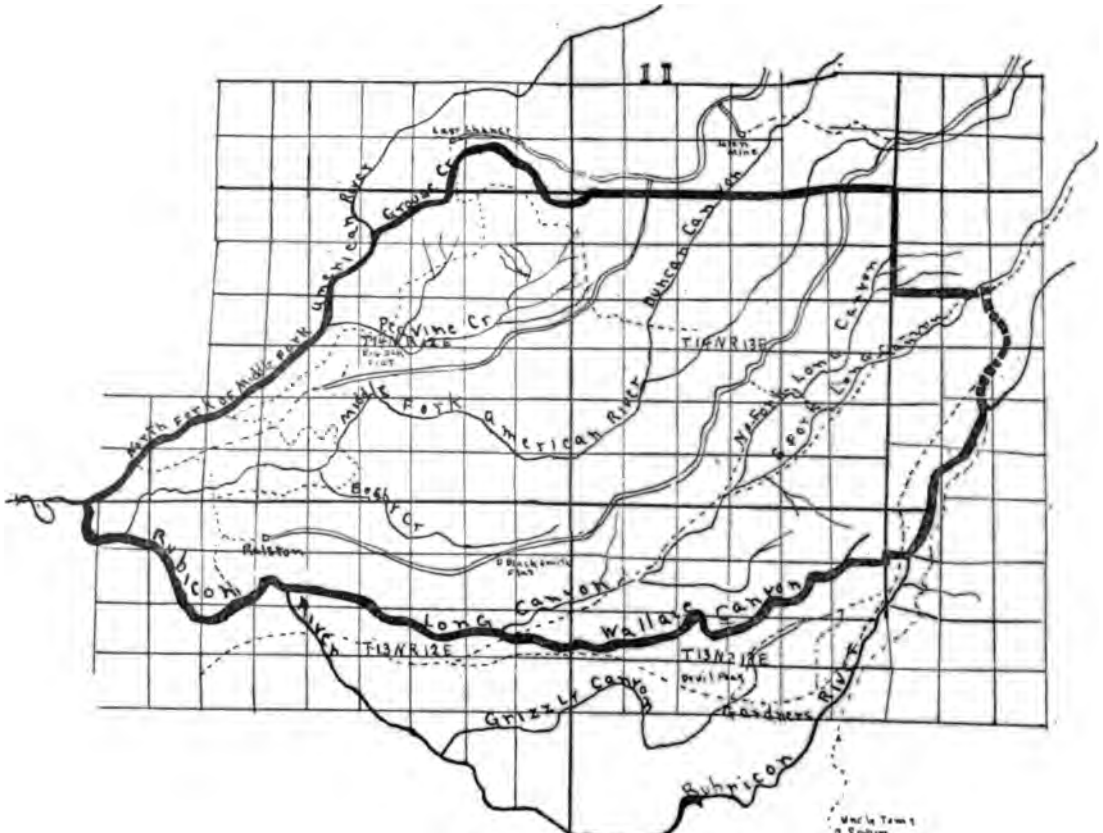


FIG. 13. Fish and Game District 1I comprises several long narrow ridges between the Middle Fork of the American River and its tributary, the Rubicon River. This refuge is well situated and has splendid natural boundaries. Brush covers the lower hills, and the flats above are covered with yellow pine. Excellent summer and winter range is furnished for deer; bear are also to be found. In fact, this refuge, situated in Placer County, is probably one of the best in the state, so far as deer are concerned.

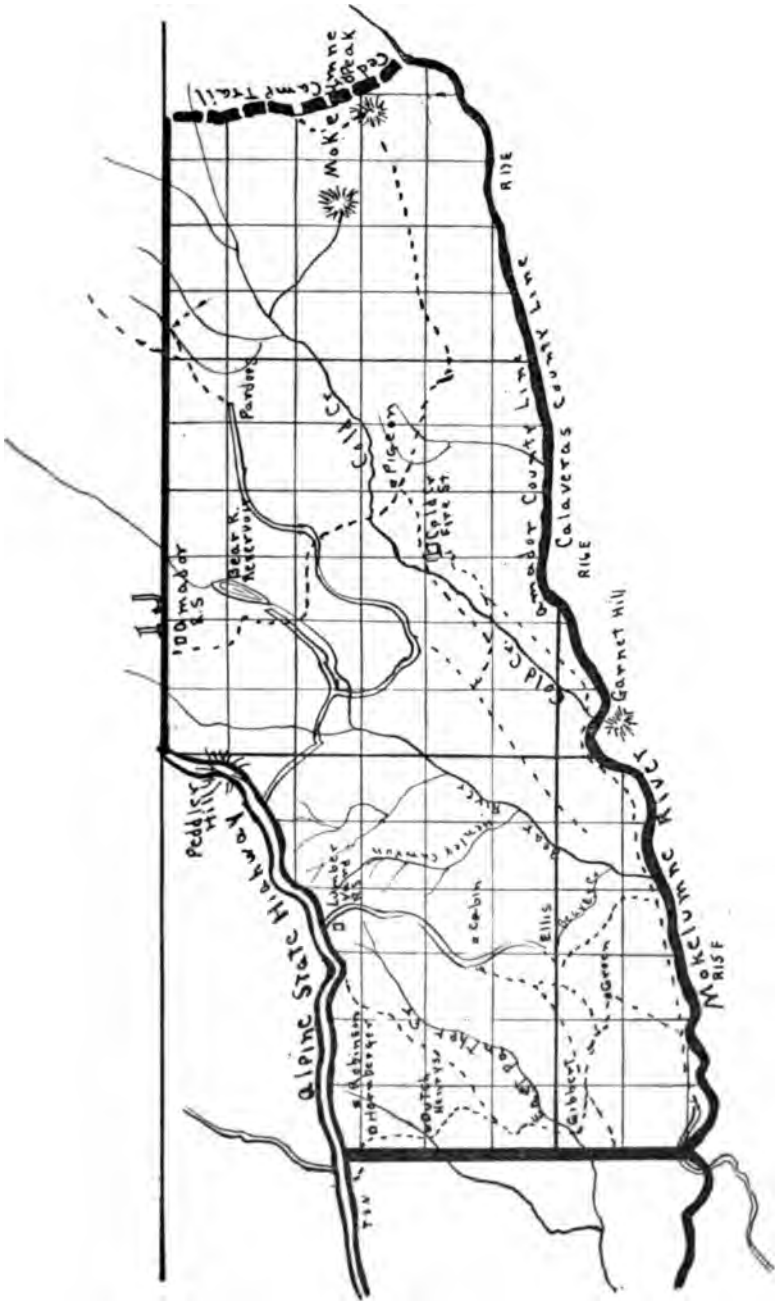


FIG. 14. Fish and Game District 1J, in Amador County, is an excellent breeding ground for deer. Within this area also deer are afforded numerous protected grounds where they may congregate during heavy snowfall. Bear are to be found in the district, as well as much small game.

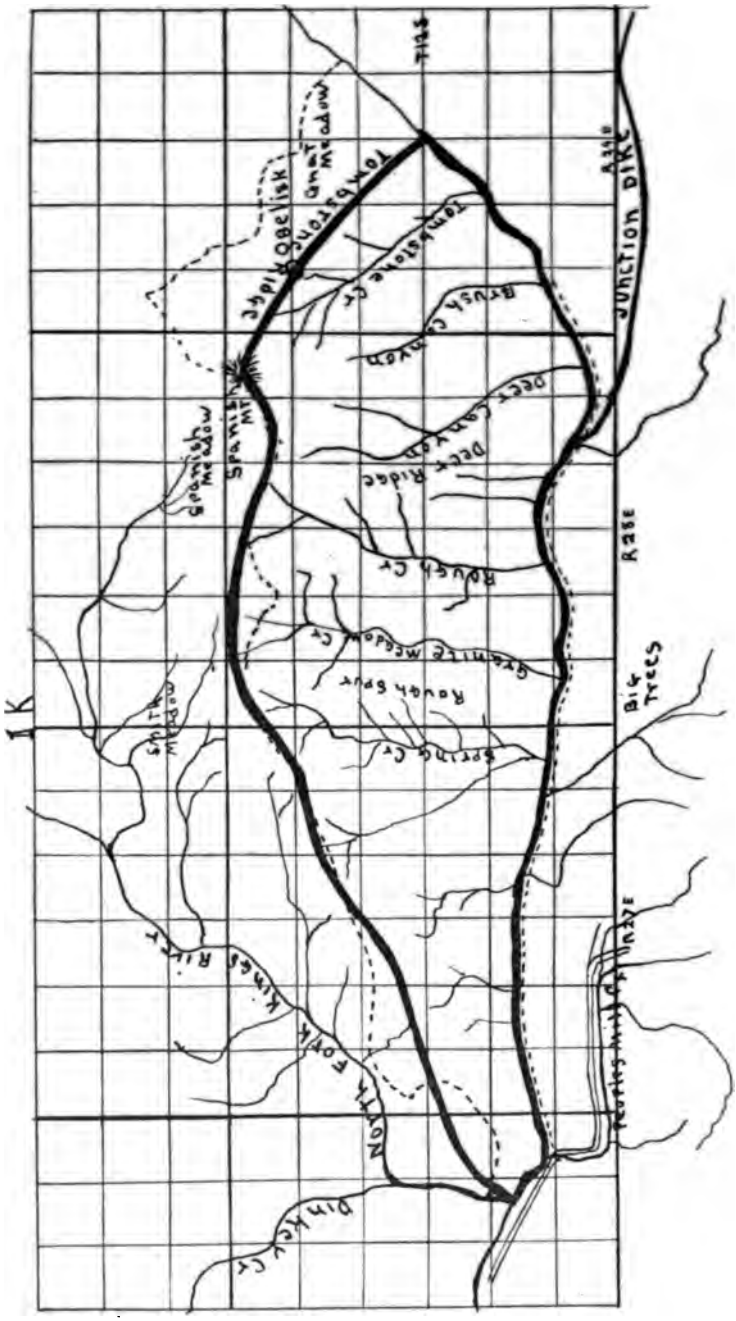


Fig. 15. Fish and Game District 1K comprises a number of ridges and canyons near the headwaters of the Kings River, in Fresno County. Forage for the large stock of big game is available both summer and winter, and the refuge should supply good hunting in surrounding territory for many years to come.

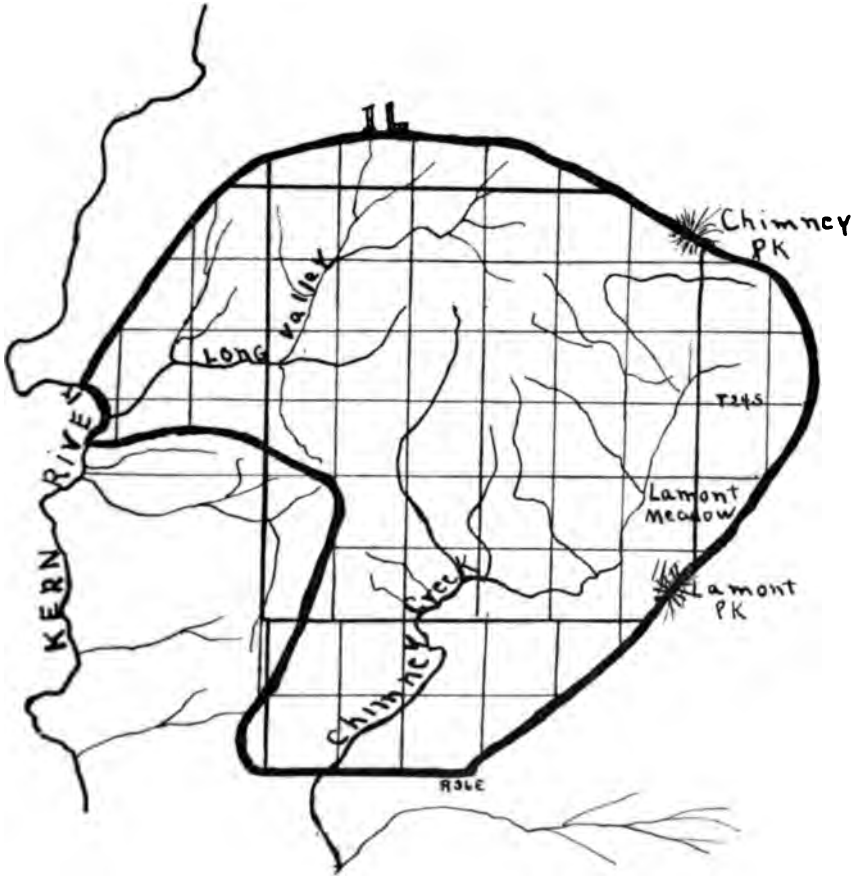


FIG. 16. Fish and Game District 1L comprises part of the drainage area of Chimney Creek, a tributary of the Kern River, in Tulare and Kern counties. Abundant food for big game is to be found. In that this district is located away from the main traveled roads, its usefulness as a refuge will increase as the country is opened up for hunters and recreationists.

FIG. 17. Fish and Game District 1M, an area surrounding Mount Breckenridge in Kern County, was recommended by an association of Kern County sportsmen and was set aside by the legislature of 1919. It furnishes a sanctuary for deer and also for small game. Concentrated hunting in the vicinity made the setting aside of this refuge urgent.

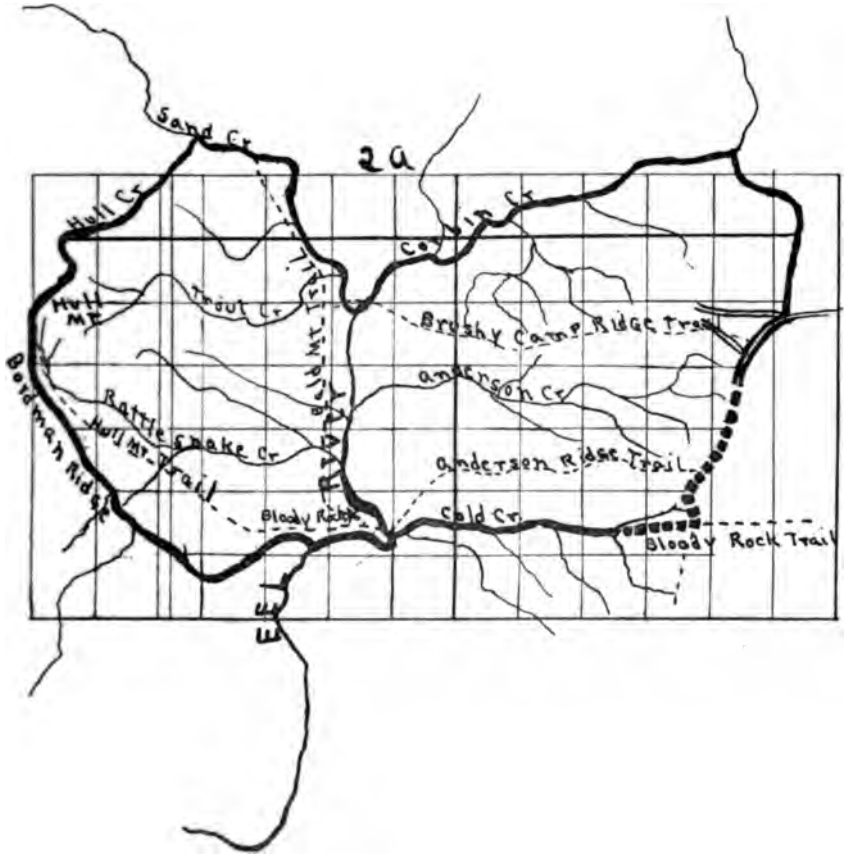


FIG. 18. Game Refuge 2A, situated in Mendocino and Lake counties, comprises a rough area on the watersheds of Anderson Creek, Rattlesnake Creek and Trout Creek, and part of the watersheds of Cold Creek, Corbin Creek and Sand Creek, tributaries of South Eel River. The elevations range from 2600 feet to 6875 feet on Hull Mountain on the west side of the area. The most important game in this refuge is deer, the area being well adapted as a breeding ground for this species. Black bear find protection, also. A few mountain quail and a few grouse are to be found on the higher parts of the area, and a few coveys of valley quail at the lower elevations.

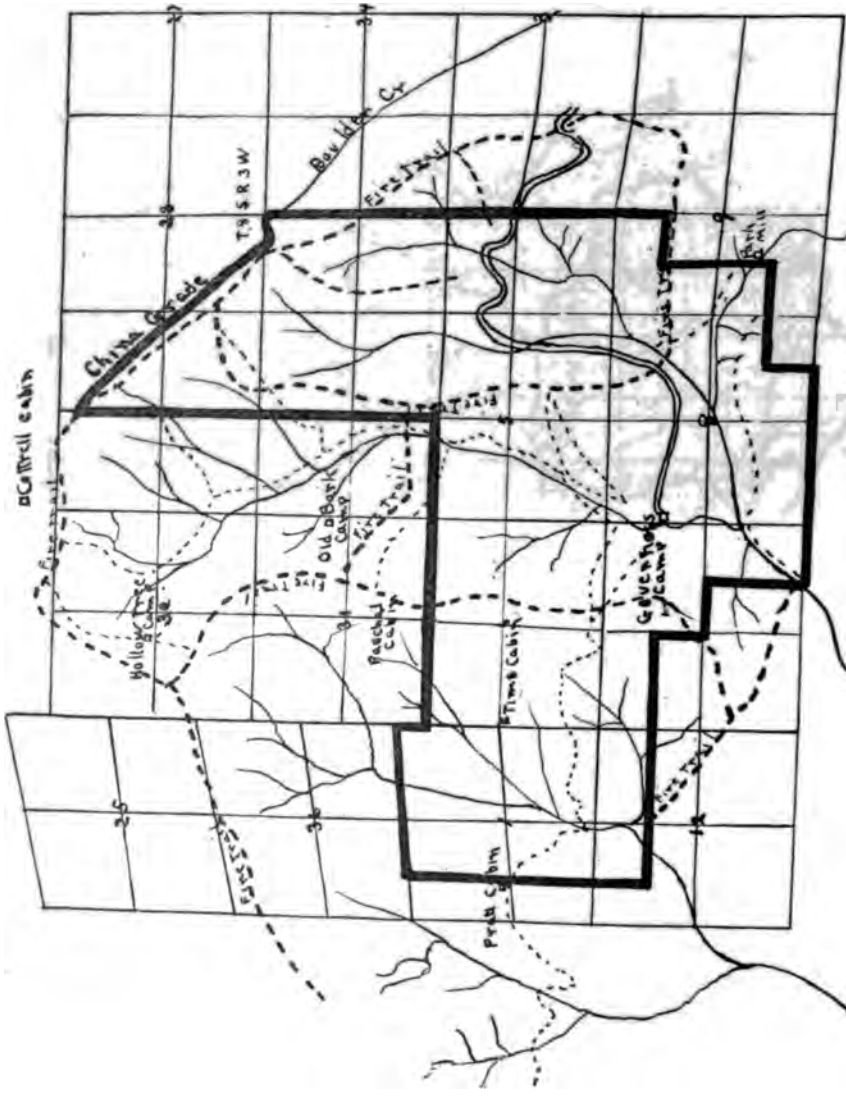


FIG. 19. Fish and Game District 3A comprises the State Redwood Park in Santa Cruz County. This is one of the smallest of the refuges but appears to furnish a safe retreat for many deer. So tame have the deer become within this area that they come at the call of the keeper and feed from his hand.

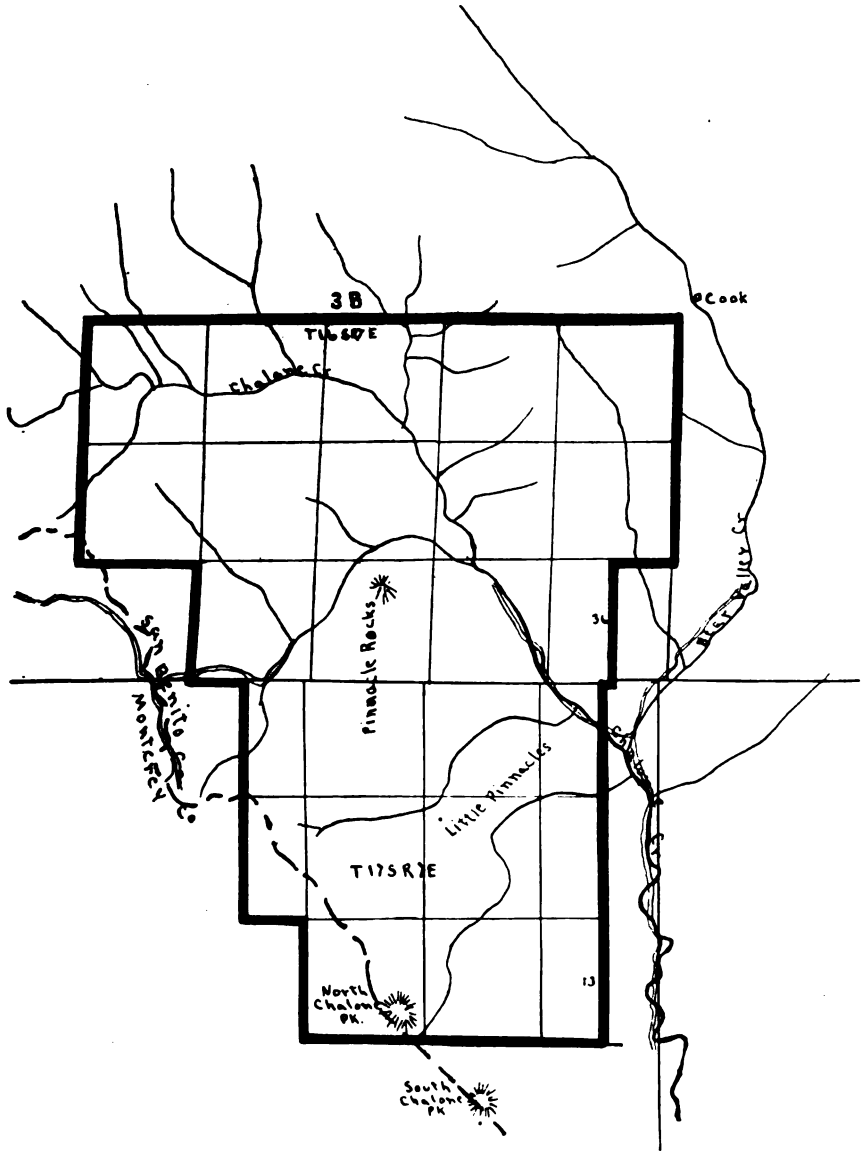


Fig. 20. Fish and Game District 3B, an area in San Benito and Monterey counties, includes within its boundaries the Pinnacles National Monument, set aside by the National Government to conserve an interesting geological formation. The refuge is much larger than the monument, and furnishes year-round range for deer. Many deer are to be found within its borders and quail are abundant.

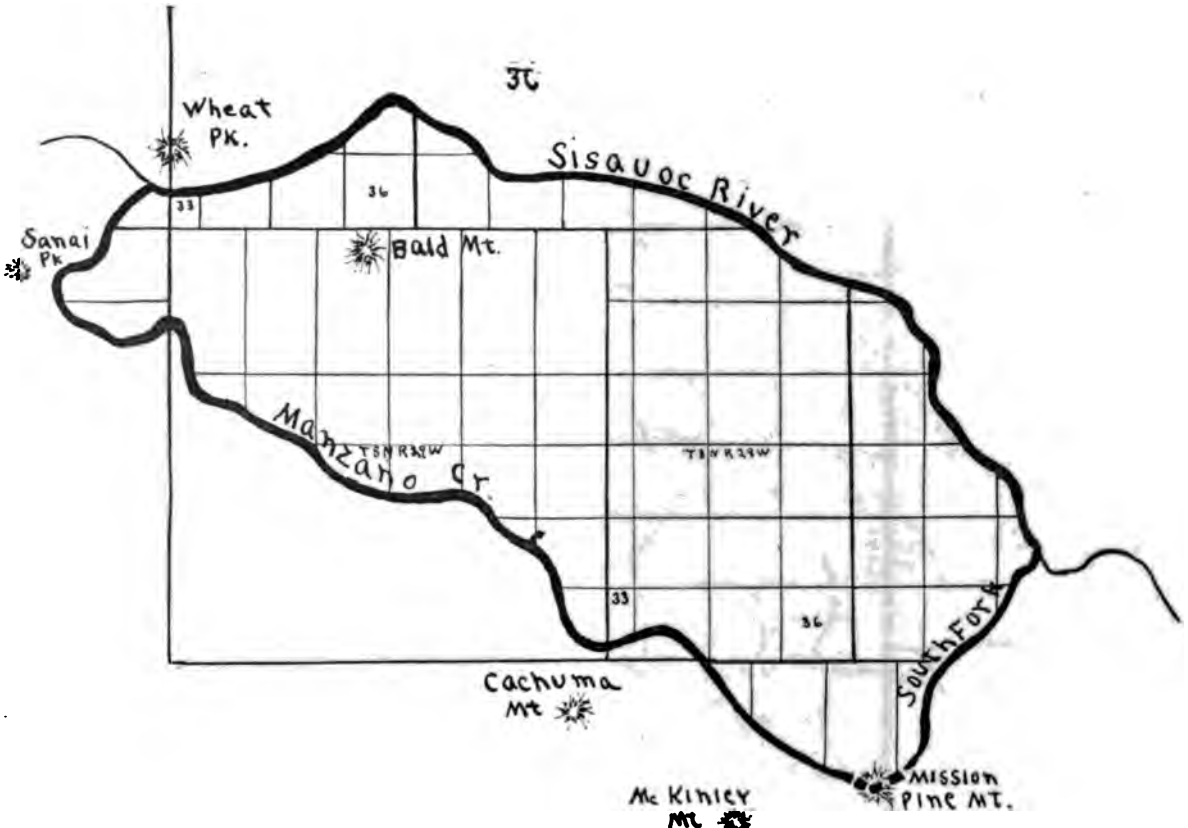


FIG. 21. Fish and Game District 3C is composed largely of a rugged ridge situated between the Sisquoc River and a large tributary known as Manzano Creek in Santa Barbara County. Numerous small canyons are tributary to these dividing streams and furnish shade and water. Numerous springs are also to be found. The cover is principally chapparal with patches of oak timber. Year-round range is furnished for deer, and quail and wild pigeons also find protection within the refuge.

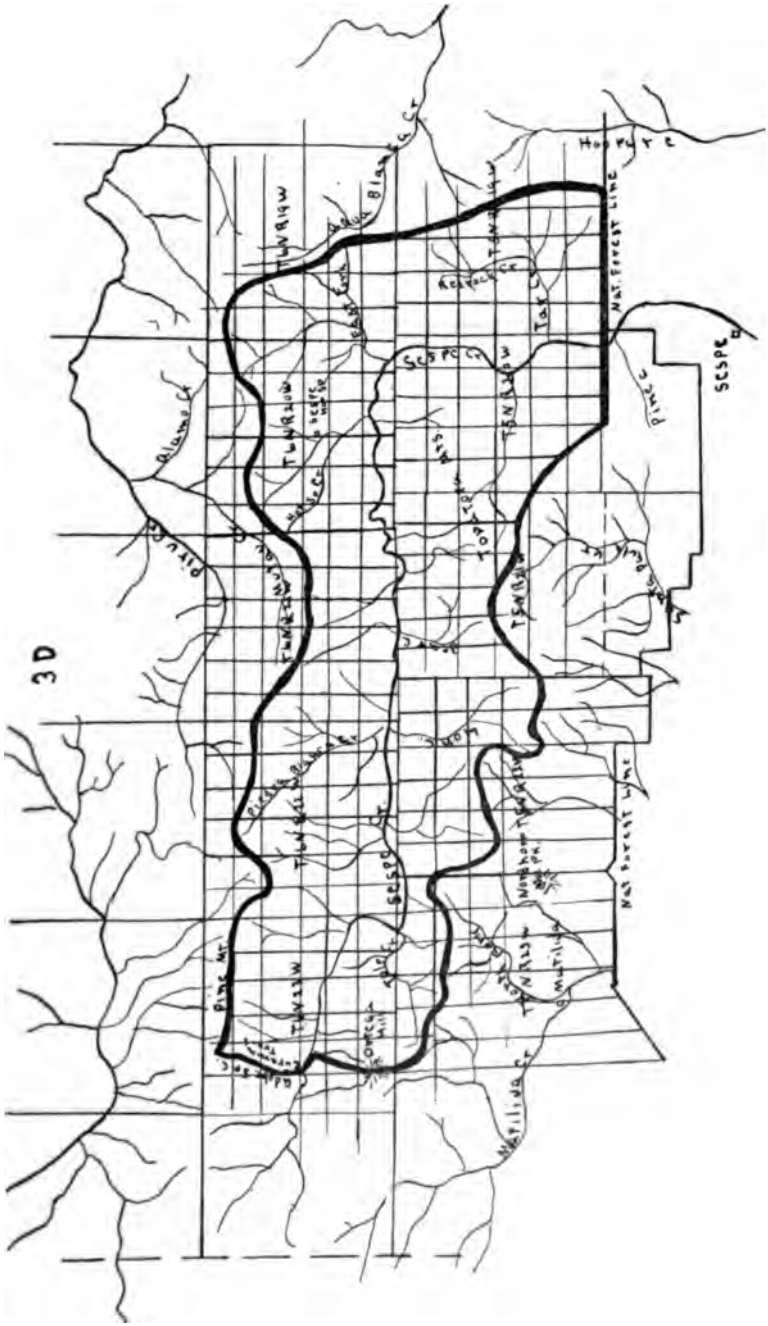


FIG. 22. Fish and Game District 3D lies in Ventura County, and comprises most of the watershed of the Sespe River where it runs in the mountains. The entire area is covered with brush, there being a small amount of pine and fir timber on the summit of Pine Mountain, and scattered forested areas in the canyons. Deer, bear, quail, and wild pigeons find protection on the area.

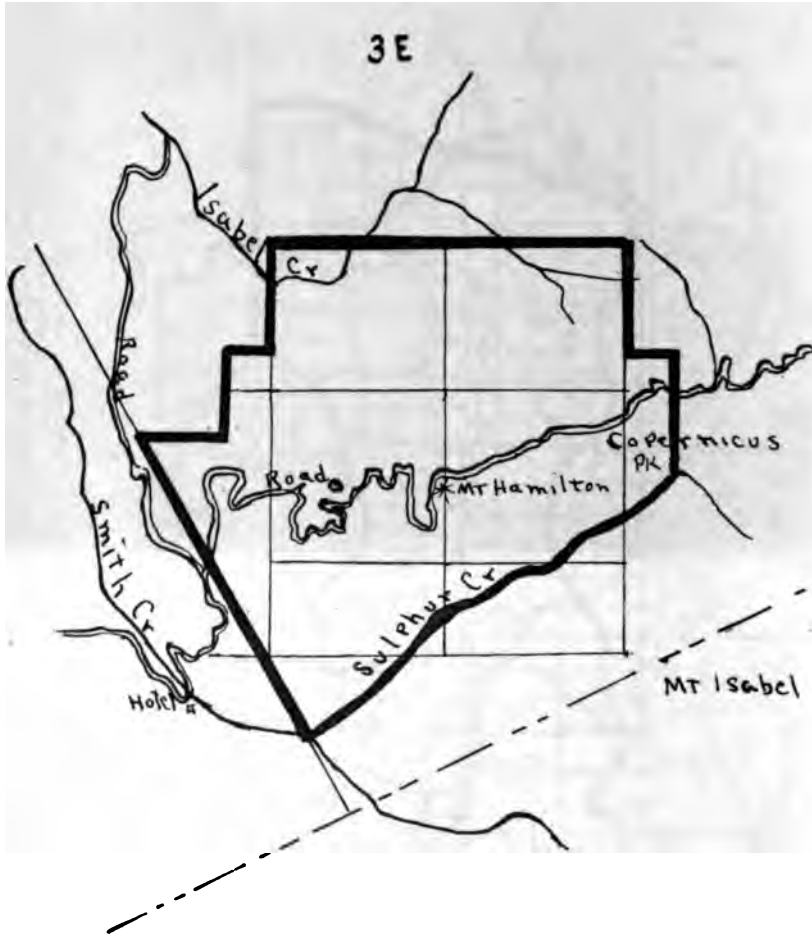


FIG. 23. Fish and Game District 3E comprises an area surrounding Mount Hamilton in Santa Clara County, being the land owned by the University of California, on which the Lick Observatory stands. This was formerly one of the favorite hunting grounds for sportsmen from San Jose, and should afford additional needed protection to the deer in that vicinity. Since the creation of this refuge, deer have increased within its boundaries many times.

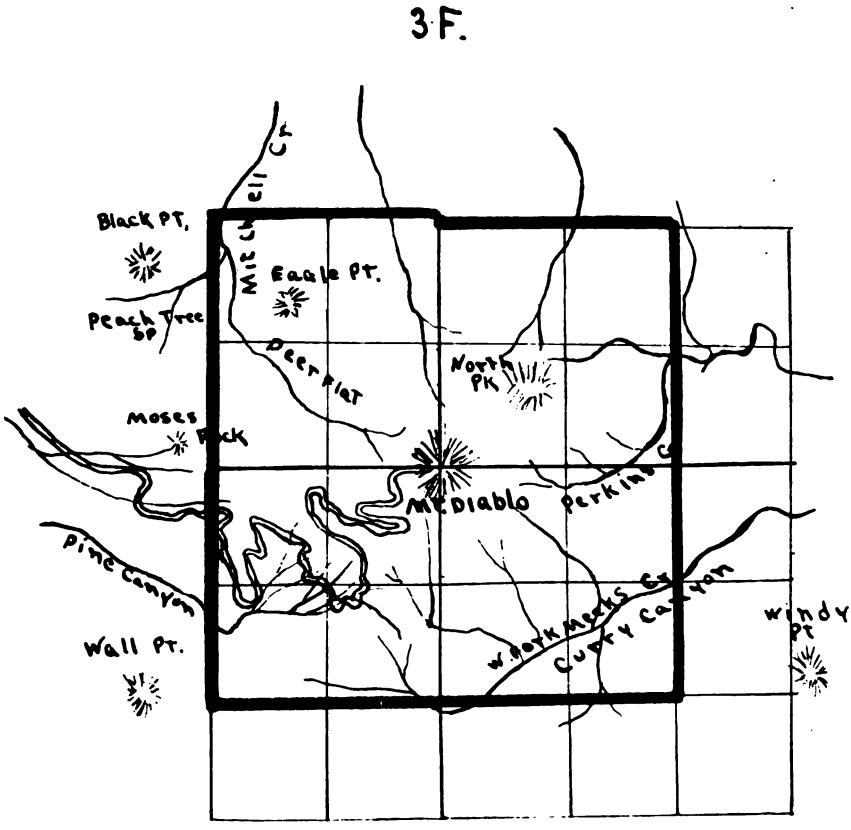


FIG. 24. The most recent refuge to be established is the Mount Diablo Park Refuge, set aside by the 1921 Legislature as Fish and Game District 3F. An attempt has been made during the past few years to improve game conditions on the mountain, and consequently there is already a supply of deer and a splendid supply of quail within the boundaries. Undoubtedly the deer will soon learn that they are safe within the area, with a resulting increase because of the safety afforded. In the end an overflow from this safe breeding place will furnish plenty of sport in the hunting territory. That sentiment strongly favored the creation of this refuge is evidenced by the small number of violations during the past year.

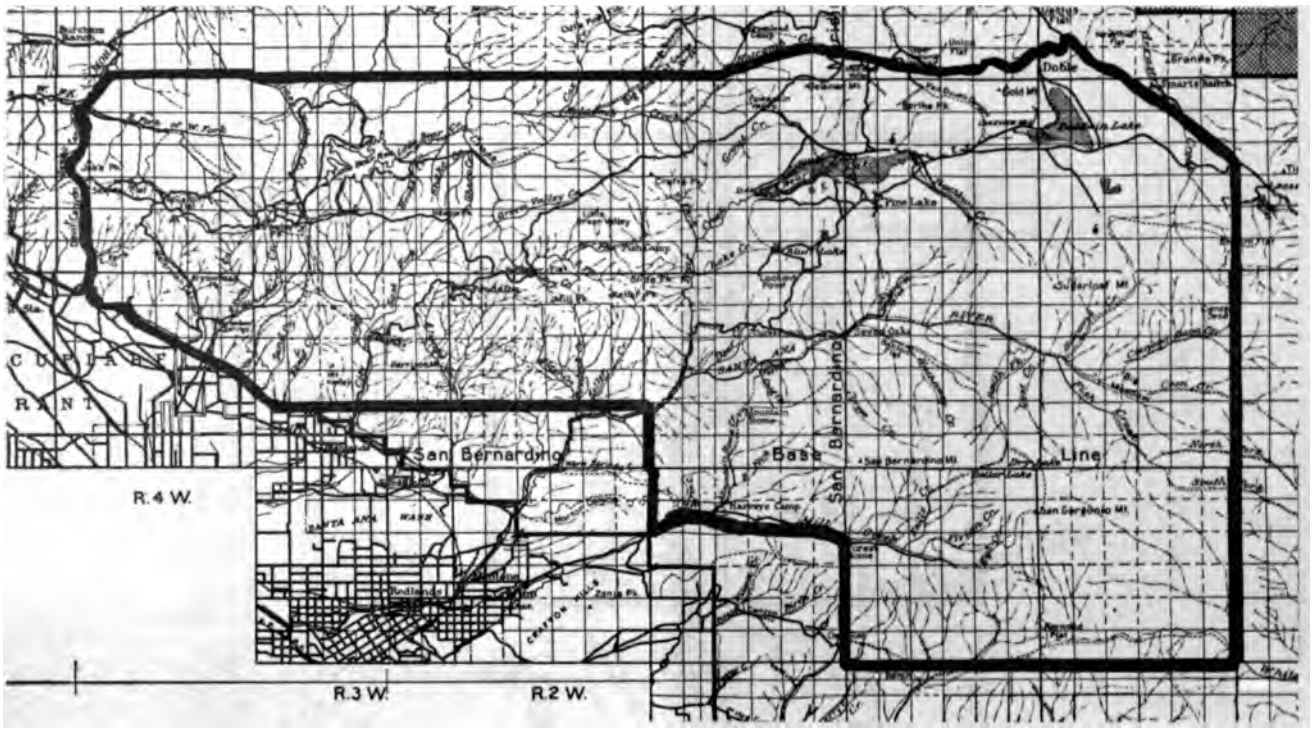


FIG. 25. Fish and Game Districts 4A and 4B, in the Angeles National Forest, taken together form the largest refuge in the state. The concentrated hunting in past years, due to accessibility from Los Angeles, reduced deer and other game to the danger point, and made these large refuges a necessity. Although there is some complaint that these areas are too large and usurp too much of the hunting grounds, yet most sportsmen agree that these areas are serving their purpose.

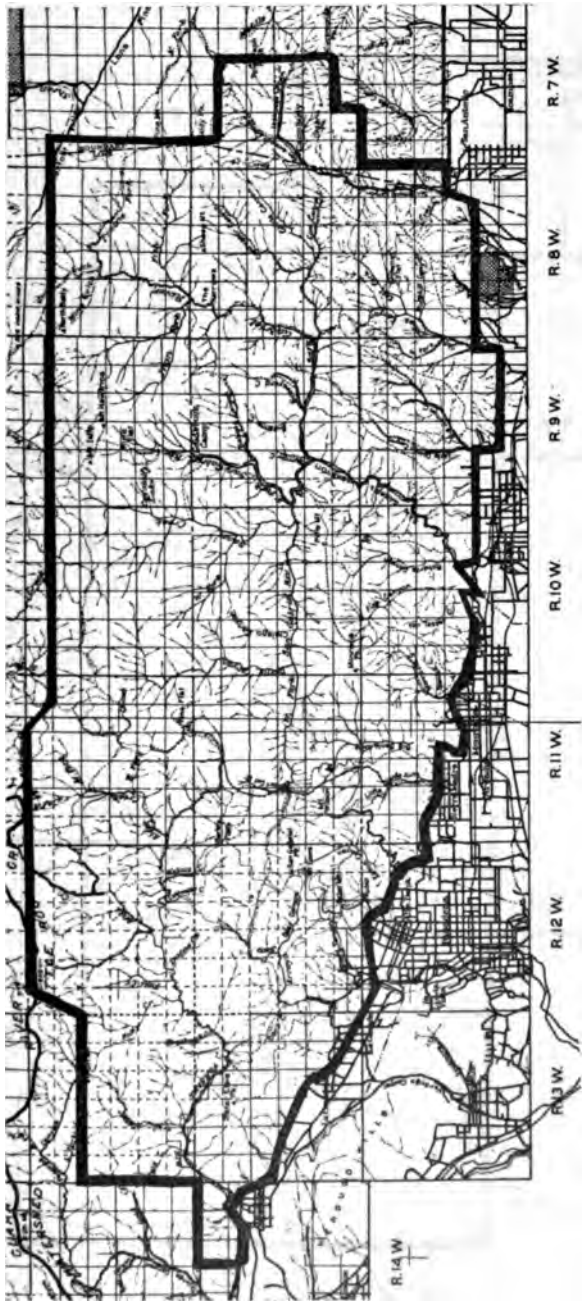


Fig. 26. Fish and Game District 4B. For description see Fig 25.

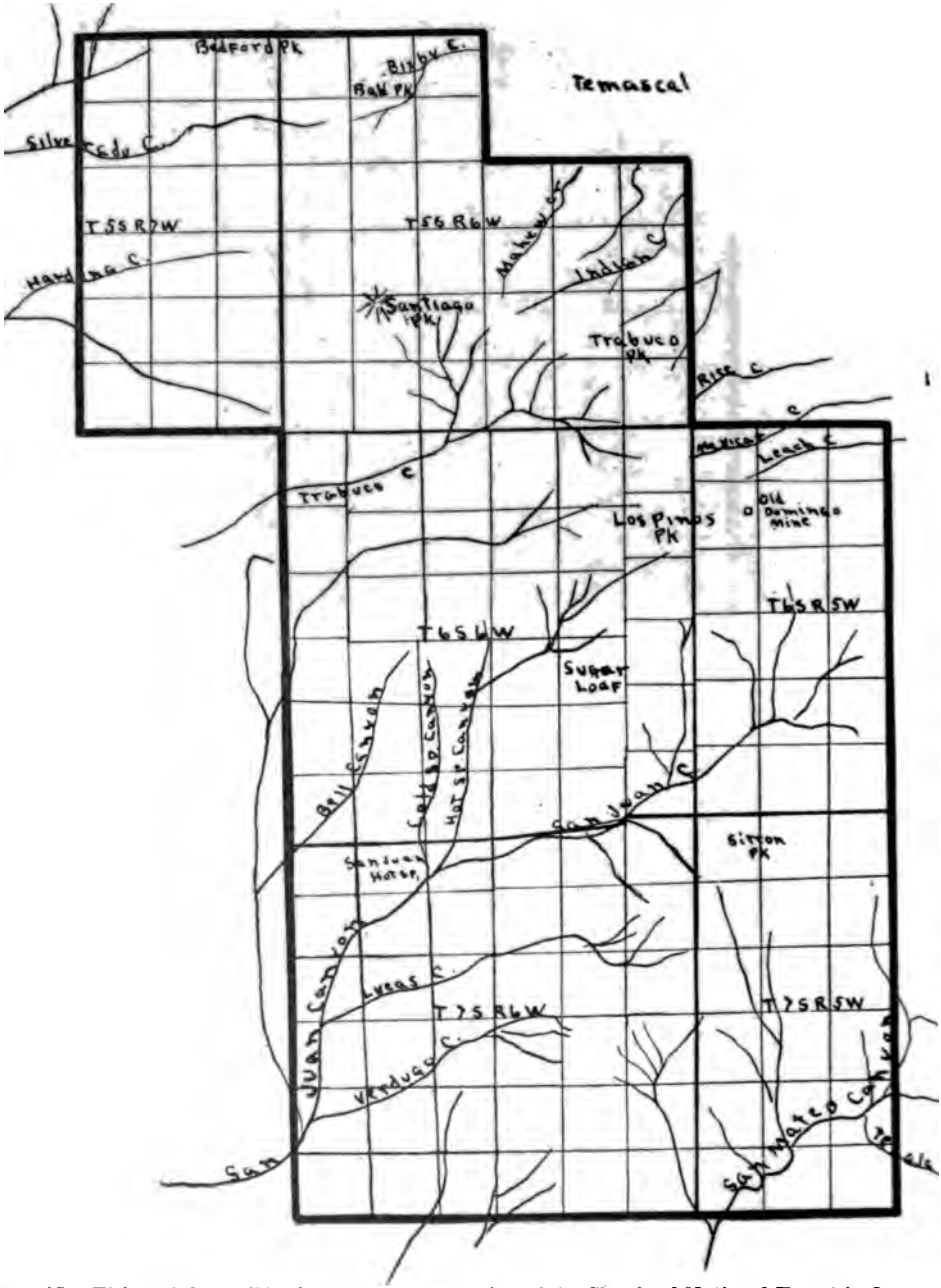


Fig. 27. Fish and Game District 4C covers a portion of the Cleveland National Forest in Orange and acts as a sanctuary for deer; also for such small game as quail and ducks. This refuge cal of the mountainous areas of the Pacific slopes of the State of California, and being near la ters of population, the need for its establishment was apparent in 1913.

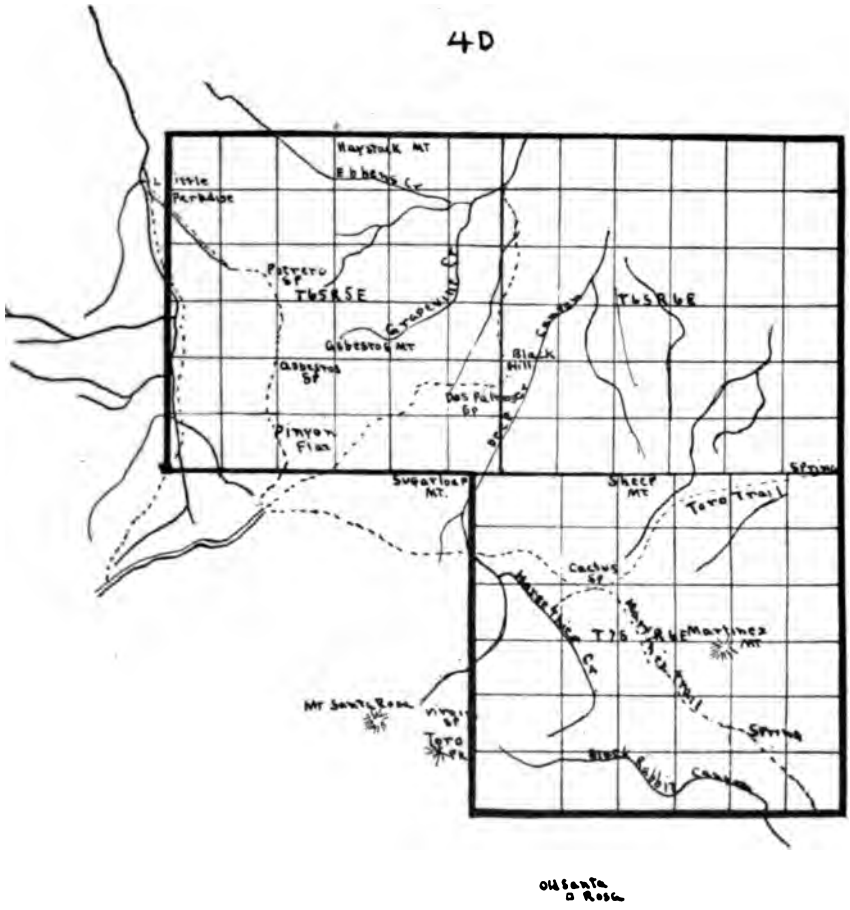


Fig. 28. Fish and Game District 4D, situated in the Santa Rosa Mountains of Riverside County, was created primarily to furnish increased protection to a band of mountain sheep that range over this territory. It is in reality the only refuge in the state which is distinctly for mountain sheep.

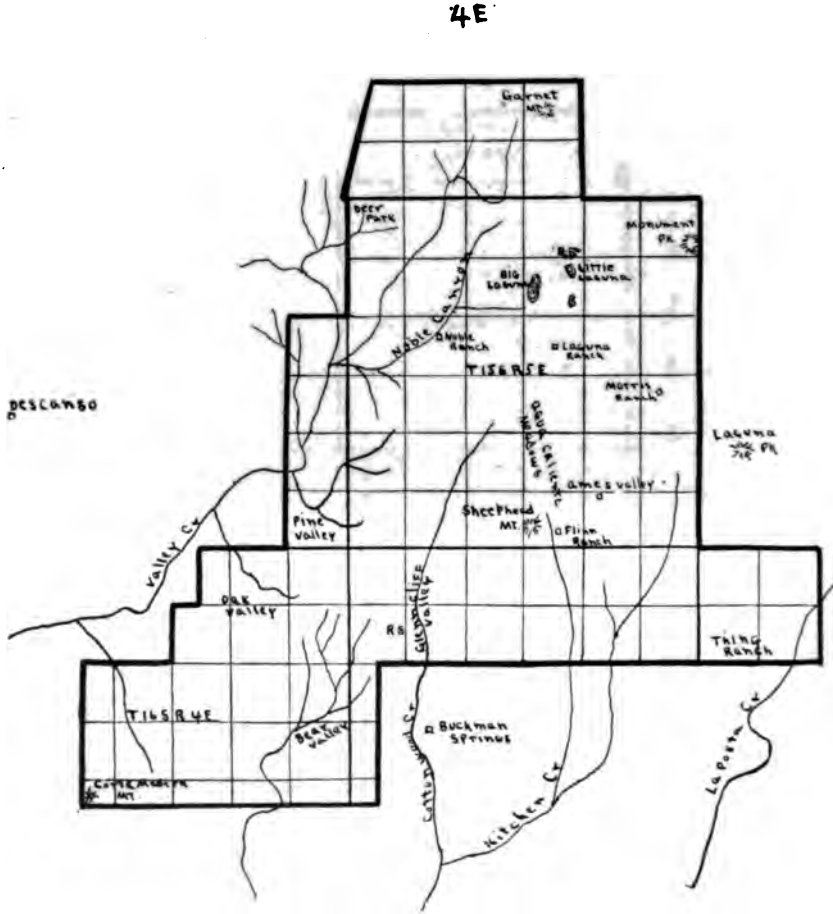
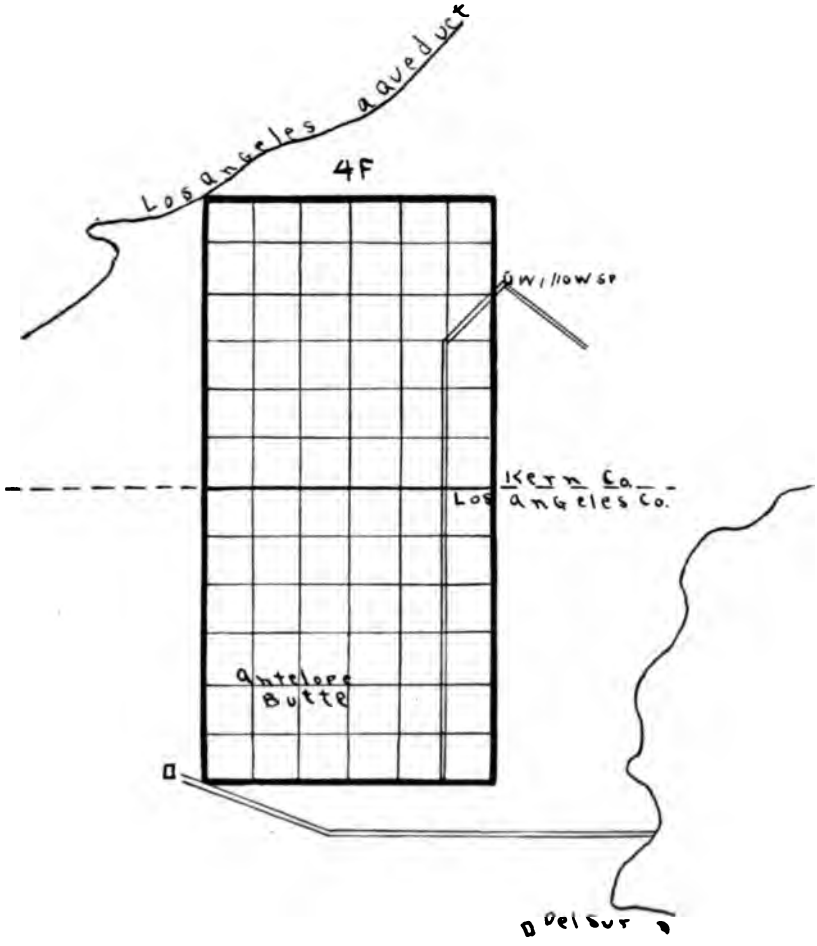


FIG. 29. Fish and Game District 4E comprises the slopes of Laguna and Cort Madera Mountains in San Diego County. The slopes are steep and covered wit brush. A few small canyons containing running water make the area especiall suited for deer and quail. Public sentiment has been strongly in favor of this mos southern of the game refuges.



. 30. Fish and Game District 4F, in northern Los Angeles and southern Kern ounties, was set aside principally to better conserve the small remnant remaining f the once large herds of antelope which formerly ranged in this region. It can be onsidered primarily an antelope refuge.

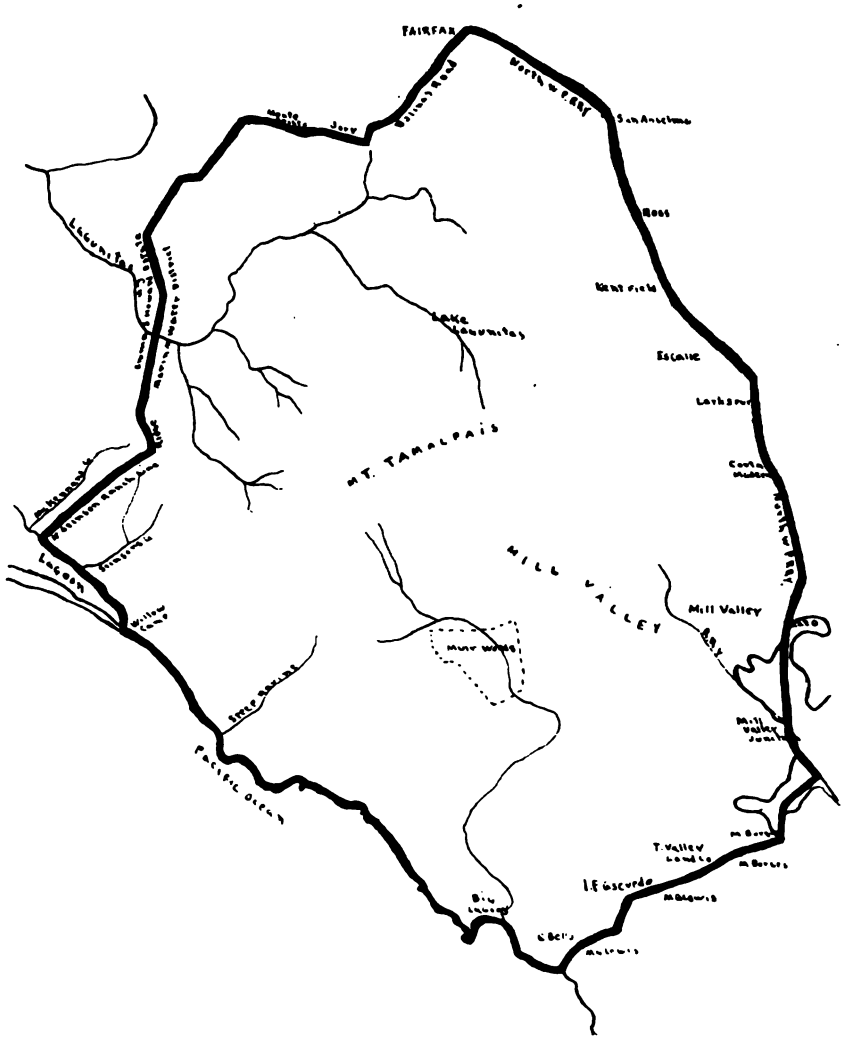


FIG. 31. Mount Tamalpais Refuge furnishes one of the greatest problems in the matter of administration. This refuge in Marin County lies close to a center of population and for years the area has been the recreation ground for thousands of San Franciscans. Before the refuge was established many were accustomed to carry firearms with them on their week-end trips, some for target practice and many for game shooting. As a consequence it has been difficult to apprehend everyone carrying firearms through the refuge. Two of the deputies from the Commission, during the year after the creation of this refuge, confiscated nearly a hundred firearms in a single day from vacationists within the refuge. If the thousands utilizing the Tamalpais Refuge as a recreation ground can be educated to the value of this refuge, it will become a very important one. Deer are numerous within its borders and there should be a sufficient overflow into the open hunting grounds to the north for many years to come.

A PIONEER ELK HUNT.*

Early the next morning we started again and at sunset, after a hard day's travel, by bye-paths, arrived at the rancho of Rafael Garcia. * * *

After enjoying Garcia's hospitality for the night, we found, on rising next morning, several of the neighboring rancheros, who had arrived on their way to the Punta de los Reyes, for the purpose of hunting the elk, with which it abounds. Sending all my men except two back to Sonoma, I resolved to remain and witness the sport, and getting fresh horses from Señor Garcia, we started for the point. I observed that the Spaniards had no arms, but they pointed to the riata, the unfailing companion of all rancheros, and exclaimed, "este es el rifle del ranchero!"—this is the ranchero's rifle. On our way, however, I observed one of the party dismount near a small grove, and selecting a straight, light pole, take from beneath his sarape a crescent-shaped weapon, which he fixed to the top of the pole. This instrument they call, from its shape, the "luna," and it is used for hamstringing the elk, which then falls an easy prey to the hunter.

The cool, bracing air of the morning promised us fine sport, as the horses, on whose exertions the sport mainly depends, would not be exhausted from the heat. But, as the Irishman devoutly remarked, "Providence never opens one door but it shuts another," a reflection verified in the present instance by the rising of a dense fog, which prevented us from seeing any considerable distance and forced us to be circumspect in picking our way over a very broken and hilly part of country. Crossing a deep valley, up which I could not see for the mist, we surmounted a high hill, and I saw in a moment that we stood on an isthmus or neck of land, connecting a lofty promontory—lying right before us—with the mainland. At the same time I discerned the sea on either hand, and heard the musical roar of the surf, as it tumbled ashore on the right. Suddenly one of my men exclaimed, in a low tone: "Hush!" and, rifle in hand, dismounted for a shot. Following the direction of his glance, toward the promontory, I perceived a band of elk which must have numbered not less than four hundred head of superb fat animals—the apparently cumbrous horns of the bucks thrown back on their shoulders, and the leaders seeming to hesitate whether it should be a fight or a foot race. Pacific councils, however, prevail, and the whole body were soon in full retreat, the old bucks occasionally stopping to gaze at us, while the does and fawns made the best of their way up the slope. Our horses scenting them at the same time—for the horses of California scent large game almost as acutely as dogs—became greatly excited, and could hardly be checked from dashing forward in pursuit.

*This account of an elk hunt at Punta de los Reyes, Marin County, in August, 1846, was written by Joseph Warren Revere, an American naval officer and a direct lineal descendent of Paul Revere, of Revolutionary times. He took an active part in the conquest of California and raised the American flag at Sonoma, California, and was its first American alcalde. He was once the owner of San Geronimo Ranch in Marin County. The article appeared in "A Tour of Duty in California," published in New York in 1849. The interesting description of the hunt fortunately overshadows the harrowing details regarding wounded animals, and the killing of a fawn, which the author includes.—EDITOR.

The rancheros seemed to despise the stealthy advance on foot of the Americans with firearms, and as the game could not escape us, being surrounded on all sides by the sea, except on that occupied by our well mounted party of six men, they planned a mode of attack, which they communicated to us. Two of them gave their horses the rein with an "adelante!" and the noble beasts sprang forward in full pursuit of the now flying herd. At this season (August) elk are fatter than at any other, and can not compete with the horse in speed, whereas, a couple of months later the fleetest horse could hardly overtake them. Their speed was now inconsiderable, the rancheros soon coming up with them and scattering them in various directions. Our friend with the "luna" had hamstrung several of the poor creatures and his companion had entangled with his riata a noble buck, which was plunging and tearing violently, the riata being at its greatest tension and the little horse, to whose saddle it was made fast, standing stiff and stark with eyeballs staring, and every nerve braced to meet the pulls and tugs of the elk; while the Californian sat coolly in his saddle and, addressing the elk by the familiar title of "cuñado" (brother-in-law), pleasantly assured him that he "only wanted a little of his lard wherewithal to cook tortillas!"—a joke which the struggling victim was in no humor to relish.

From the contemplation of a scene so new to me, I was aroused by Don Egedio (Giles), who loudly called to me to shoot, and, turning my horse, I spurred him nearer the precipice, between which and myself the remainder of the band seemed disposed to rush, on their way back to the mainland. My horse was an admirably trained animal for the purposes of hunting after the fashion of California, but he would not stand still enough for a shot from the saddle; and to have dismounted would have been to lose him, as he would have pursued the elk. But a shot I was determined to have, on some terms, and so, when it seemed to my rather obfuscated vision that I was opposite the thickest of the band, I wheeled, seized my double-barreled gun, and pulled both triggers at a venture. My horse, unused to fire, jumped some twenty feet, more or less; I dropped my gun but kept the saddle. My shot accidentally took effect, for when I was able to rein up, I returned to the spot and saw a poor doe lying in a reclining position, the blood welling rapidly from the frightful wound inflicted by two heavy buckshot cartridges which had taken effect in the animal's shoulder. The unfortunate fixed upon me her large full eye, expressive at once of fright, sorrow, and reproach, and the mournfulness of the scene was heightened by the presence of a half-grown fawn, baaing and bleating around its dying mother. Sentiment, however, soon subsides on the hunting ground, and after my friend with the "luna" had coolly drawn his knife across the throat of the doe, I felt little compunction in bringing down the sorrowing fawn. In the meantime our friends on the point had not been idle, having taken toll of two more of the flock as they passed, one of which was caught with a riata by a Spaniard and an Indian vaquero, and the other shot by one of my men. It usually requires two men with riatas to kill the animal, the object being to trip him up and then give him the coup-de-grace; but

one man sometimes does it alone with a riata and luna, and there are rare instances when a single expert hand trips up the animal with his riata and then finishes him.

The herd had now retired to the mountains, and were dispersed among the crags and precipices, almost inaccessible to horses. Our party collected and rode down the point, where we found three hamstrung animals which had wriggled and screwed themselves into the most retired places. Our friend of the "luna," however, insisted with many round, full-mouthed oaths, that he had disabled nine and wounded some others in a desperate manner, with the points or horns of his iron. But these people can not be implicitly believed, and after traversing the point in every direction, we could find but one more elk, which had fallen over the precipice and lay half his length in the sea, the vultures and sea-birds already hovering over him in great numbers, impatiently awaiting the moment when death should make him their own.

CALIFORNIA FISH AND GAME

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All material for publication should be sent to **H. C. Bryant, Museum of Vertebrate Zoology, Berkeley, Cal.**

FEBRUARY 3, 1922.

"One thing now should be apparent to the dullest mind. It is that unless a great number of game sanctuaries are made and maintained inviolate for the safe breeding and increase of big game, the noble sport of big game hunting will be a thing of the past."

DO WE NEED MORE GAME REFUGES?

A survey of the game refuges in California will show that they are numerous, well distributed, and that many of them are of large size. Whether the policy of creating such refuges should be continued or ended, is a question which needs to be fully considered at the present time. On the one hand there is complaint by many hunters to the effect that all of the good hunting grounds are now within game refuges; on the other hand there is demand from conservationists for increased protection. Possibly the most dependable conclusion will be forthcoming after the test of time has been applied. Should the present refuges be able to maintain big game in sufficient numbers, the matter would be settled.

Some states have adopted the slogan: "A refuge for every county" or even "A refuge for every township," and it may be that the conservation of upland game birds demands the creation of a large number of small refuges. Our obligation to big game, however, seems to be satisfactorily met in the present series of twenty-eight refuges, most of them set aside especially for big game.

INTERNATIONAL BIRD PROTECTION.

The apparent benefits accruing from the joint protection given migratory birds in Canada and the United States has promoted discussion as to the possibility of arranging treaties with other countries of Central and South America, in order to secure such protection for migratory birds in those countries as is afforded them in North America under the existing treaty between the United States and Great Britain. In January, 1920, a resolution was presented to the President by the Committee on Foreign Relations, asking that a treaty be proposed between the United States and the Latin-American republics for the protection of birds which migrate between the United States and such countries.

The President, acting on the report of the Secretary of State, and also the report of the Secretary of Agriculture, stated that in view of existing conditions the time did not seem opportune to undertake the negotiation of a treaty for the protection of migratory birds with the Republic of Mexico, and that in the case of most of the republics of Central and South America treaties are unnecessary at present, although in the case of Brazil and Argentina such treaties might be of advantage.

In order to obtain more definite information before the negotiation of conventions with these countries was undertaken, Dr. E. W. Nelson, Chief of the United States Biological Survey, sent an agent to Argentina, Uruguay, Paraguay and southern Brazil for the purpose of securing needed information concerning the conditions relating to such of our migratory birds as winter in those regions. Further steps looking toward the execution of treaties with these countries will depend on the report of this agent.

IMPORTANT CONVICTION SECURED.

The Fish and Game Commission recently secured a conviction in an important case involving the violation of the law relating to the taking and shipping of trout. This case is of interest to all who favor the enforcement of the fish and game laws of the state, and especially to

those who are aware of the amount of time, money and labor spent in propagating trout and supplying the streams with this gamey fish.

For several months the Commission worked quietly but effectively on an investigation of the violation in question, and the result was the apprehending of two Alameda gentlemen who had for some time been sending packages of smoked trout through the mails from Tuolumne County, thus laying up a private supply of fish for their use during the winter. Simultaneously with the seizure of two boxes of fish as they reached their destination, the two men, with 50 trout in their possession, were arrested in Tuolumne County by a Forest Service deputy. This evidence, taken together with the trout in the two boxes, confirmed the suspicion that these parties were in the habit of taking trout beyond the legal limit.

The case was tried before Judge Wilkinsky of Sonora, and the court fined each offender $75 for exceeding the bag limit and $25 each for shipping the two boxes of smoked trout to Alameda by parcel post. Later a search was made of the residence, where about 200 smoked trout were found and confiscated.

It may be well to state that the law provides that a fine of $25 may be imposed for each lot of fish or game shipped by parcel post, and from $25 to $500 for any catch in excess of the limit, or imprisonment of not more than 150 days, or both. The Fish and Game Commission has the right to inspect the offices of express companies, although there is no provision in the law giving the right of access to post offices.

HUNTING ACCIDENTS—1921.

Since the publication of the note regarding hunting accidents in the last number of CALIFORNIA FISH AND GAME, there has appeared what may be called almost an epidemic of hunting accidents. Judging by newspaper accounts, hunting accidents have been more numerous during the last year than for several years past, as a compilation of the accidents coming to our attention shows. Undoubtedly this compilation is incomplete, as newspaper items have formed the only source available, since hunting accidents are not distinguished from other accidents in the statistics of the State Board of Health. The list is published as a warning to those who go afield with a gun. If simple warning of danger is not effective in reducing the number of hunting accidents, it may be that the sight of a long list of persons actually killed and numerous others wounded, through their own or some one else's carelessness, may impress persons with the need for great precaution to avoid the taking of human life.

HUNTING ACCIDENTS, 1921.

Killed.

Name	Shot by	Date, 1921	Locality	How shot
James Anderson (14)	Self	October 15	Marshes, Seminary Ave., Oakland	In effort to repair gun, Anderson looked into muzzle of gun, which accidentally discharged, resulting in instant death.
David Hoover	B. J. Blaze	September 11	Bell Station, Santa Clara County	Mistaken for a deer.
Clifton Madison (13)	Self	September 24	Leona Heights, Oakland, Alameda County	Accidental discharge of gun while climbing out of abandoned mine shaft.
George W. Staton	Richard Williams	October 1	Suisun Marshes, Solano County	Duck hunting. Victim stood up in motor boat just as companion fired at flock of birds.
Jack Swartz	Red Hall	October 6	Bakersfield, Kern County	Mistaken for a deer.
L. R. Samson	Self	September 11	Ukiah, Mendocino County	Accidentally discharged gun on return from hunting trip.
Charles C. Berwick	Self	November 27		Accidental explosion of gun wounds arm and hand, death resulting from infection.
Gordon H. Sawyer, Jr.	W. L. Minaker	December 4	Woodland	Hunting in rice fields, gun accidentally discharged.
Alfred C. Musso (17)	Self	November 5	Bowman, Placer County	Grasped gun by the muzzle and beat the bushes with the butt to scare out the quail.
Anker Boegh (19)			Franklin, Sacramento County	Gun in front seat of automobile exploded, resulting in instant death.
George Granelli (11)	Self	December 22	Sherman Island, Sacramento Co.	Accidental discharge of rifle while hunting ducks.
John Pellester	Self	December —	Helena, Trinity County	Slipped in snow and accidentally discharged gun while hunting panther.

Wounded.

Dillion Allard	Self	August 21	Ukiah, Mendocino County	Accidental discharge of pistol; leg wounded.
George Shellford (14)		August 1	Pine Flat, Sonoma County	Accidental discharge of rifle.
Robert Clark, Jr. (16)	Companion	August 3	Ventura County	Shot in the hip by companion while hunting deer.
Norman Donohue (15)	Self	March 20	Ventura County	Arm shot off half way between elbow and wrist, as he was crawling through a fence in the river bottom.
James Nelson	Harry Moore	October 1	Newman, Stanislaus County	Companion stumbled and fell, gun discharged hitting Nelson in leg. "Dangerously hurt."
Robert Skinner	H. H. Spangle	September 9	Helena, Trinity County	Mistaken for a deer. Tore hole in arm and wound in side.
Prof. J. G. Brown,	Mr. Bassett	September 23	Near Redding, Shasta County	Mistaken for a deer.
Emmet Frye (14)	Father	September 8	Stonyford, Colusa County	Mistaken for a deer.
Frank Miller (16)	Self	March 28	Martinez, Contra Costa County	Accidentally discharged gun. "Will not likely recover."
J. T. Zirling (20)	Unknown		Near Auburn, Placer County	Stray shot passed through lung.
Homer Smith, (19)		November 24	Antioch, Contra Costa County	Accidentally shot in the leg while hunting. "Amputation found necessary."
K. I. Schofield	Self	September 3	Santa Barbara County	Shot in arm while attempting to pull gun through fence.
M. Fontaine		November 4	Calaveras Valley	Thrown from motorcycle when machine skidded and ran into brother's car. Victim's back broken.
Tony Marvinna	Frank Sepada	August 5	Upper Bayo, east of Mount Hamilton, Santa Clara County	Mistaken for a mountain lion.
Frederick K. Burkett (15)	Ed. Maurrer	September 13	East of Mount Hamilton, Santa Clara County	Mistaken for deer. Spinal column injured, resulting in complete paralysis of the lower limbs.

"PUBLIC SHOOTING GROUND-GAME REFUGE BILL."

Through the enthusiastic and timely efforts of sportsmen and the cooperation of Congressmen and Senators, there has been introduced and is now pending before Congress a bill known as the "Public Shooting Ground-Game Refuge Bill"—a bill on which the future of the sport of duck shooting depends. These men have realized that because of the disastrous results from inadequate game protection, it has become most essential that suitable territory shall be set aside for all time to come, to act as breeding, feeding and resting places where birds are free from molestation, if the birds and the sport of shooting them are to be perpetuated.

The main provisions of the bill include the establishment of shooting grounds for the public, the establishment of game refuges and breeding grounds for protecting migratory birds, and a federal license to hunt migratory birds.

The federal license of $1 is to be paid by the sportsman who hunts migratory birds, and not by the taxpayer, and is to be issued by any postmaster. It shall become void after the thirtieth day of June, next succeeding its issuance.

The federal license will in no way supercede the state license or relieve the gunner from his obligations to his state laws. The funds derived from the license sales are to be used for the purchase or rent of refuges and shooting grounds where territory is available and where the greatest good will result. The shooting grounds will, of course, be distributed as equally as possible over the different states, depending upon available areas that are suitable.

The bill further provides for the creation of a commission to be known as the "Migratory Bird Refuge Commission" to be composed of the Secretary of Agriculture, the Attorney General, the Postmaster General, two members of the Senate (to be selected by the President of the Senate) and two members of the House of Representatives (to be selected by the Speaker), to arrange for the purchase or rental of the refuges and hunting grounds; which commission is to make an annual report of its activities and expenditures to Congress.

Any employee of the Department of Agriculture, authorized by the Secretary of Agriculture to enforce the provisions of this act, is to have power to arrest without warrant any violators he may apprehend, and with warrant to search any place.

Any violation of the act, or any regulations made pursuant to the act, shall constitute a misdemeanor and shall be subject to imposition of a fine of not more than $500, or to imprisonment for not more than six months, or both.

NOTABLE ARRESTS AND CONVICTIONS.

Deputy Burke recently apprehended two men in San Mateo County, killing deer at night with a spotlight. A jury trial before Judge Johnson resulted in fines of $200 each for the men. Notice of appeal has been filed by the defendants.

Deputies in various parts of the state have recently made many arrests for the taking of game fish between an hour after sundown and an hour before sunrise. Fines have been imposed in every case.

In September an Italian in San Mateo County was arrested by Deputy Burke for having in his possession quail and non-game birds. Judge Griffin fined the man $200.

Deputies in the duck section of the Sacramento Valley have made numerous arrests for night shooting and over-the-limit of ducks. Fines ranging from $50 to $200 have been imposed.

Deputy Atkinson recently arrested a man for killing deer within Fish and Game District 4C, a game refuge in Orange County. Judge Cox of Santa Ana imposed a fine of $100.

Deputy Bundock recently apprehended a hunter with a doe in his possession. Judge J. S. Fitzgerald of Livermore imposed a fine of $150.

Deputy Tibbetts arrested two parties for having in possession eleven quail within Fish and Game District 1M, a game refuge. Judge F. Bunnell fined each $100.

On October 30, Deputy Armstrong and Deputy Steele arrested eleven men for shooting from power boats. Judge Prince of Benicia fined each $25.

A fisherman was apprehended by Deputy Sherwood with over-the-limit of salmon and was fined $100 by Judge W. S. Rice of Modesto.

Two duck hunters with over-the-limit of ducks were arrested by Deputies Britton and Carpenter on November 26. Judge Farnum of Willows, finding them to be old violators, fined each $100.

Fines of $25 each were meted out to five men found night shooting by Deputy Ludlum and Deputy Stanley.

On November 11, Deputies Willard, Britton and Carpenter arrested two market hunters found night shooting. Each was accorded a fine of $100 by Judge Farnum of Willows.

Forest Deputy N. Phillips arrested N. Alvarez for taking fish with an explosive in Madera County on August 28, 1921. Judge Bennet of Madera sentenced the violator to 100 days in jail.

"SAVE NOW OR LOSE FOREVER."

Such an excellent editorial on the subject of protection and conservation appeared recently in "*The Gull*" (Vol. 3, No. 11, pp. 3–4) the publication of the Audubon Association of the Pacific, that we wish to quote a few extracts therefrom. The editorial was incited by an article appearing in the bulletin of the Audubon Society of New Hampshire.

Attention is strongly drawn to the fact that "the trees of our forests need the birds even more than the birds need the trees." "This matter of interdependence of plant growths and birds upon each other is one which escapes the notice of most people and the most serious task confronting Audubon societies today is to bring this point home to every community and every family and to every individual." The average man is in great danger of losing sight of the damage which will be done by the insects which would have been disposed of if certain useful birds had been spared instead of being so thoughtlessly killed because of a slight personal loss in fruit or grain.

"Man can protect his orchards and city shade trees to some extent by the expensive process of spraying, but when it comes to all the trees in all the woods, he is powerless. We see his helplessness in the case of fungi diseases, such as the chestnut blight and the white pine blister rust."

Vast sums of money have been expended by the government in an effort to check these agents of destruction, and vast sums must still be expended and many years spent in a further effort to control the situation.

"So we can easily appreciate the impossibility of man's efforts being able to check insect depredations in our forests.

"The cycles of Nature are vast; the life of man, short. Everything he requires, save air and water, is limited and measured out to him, but he is only now beginning to concern himself with the diminutions which have resulted from his own recklessness and waste. In so far as living organisms are involved in these problems, future generations will be fortunate indeed if they progress rapidly enough in knowledge and intelligence to identify the interrelation of living things in time to preserve those forms which are essential to their own well-being. Up to the beginning of the present century, we have fatuously confined our researches to the discovery of substitutes for what we have wantonly destroyed or carelessly ignored. While our country was sparsely inhabited, and while enormous areas were left, wherein the unbalancing influence of man had not yet been felt, there was always the consolation of unmeasured abundance upon which to draw. This is true no longer. We of this generation have enjoyed many things which will be denied to the next one. Turning to the examples cited above, enormous areas of chestnut have disappeared. The white pine is attacked by a rust which we think we can control by destroying two other useful growths, albeit at inordinate cost of time and money. No offset has yet been found for the depredations of the borers which are slowly but certainly eradicating the tamaracs in the Sierra. The questions we must face are: What will come next? When shall we recognize its occurrence? How long will it take to discover the cure? Shall we be able to apply the remedy?"

FARMERS' LAMENTATIONS.

Certain native California birds eat growing crops and occasionally cause real damage. Too many farmers, however, attempt to exaggerate depredations. Many letters received regarding such depredations remind us of the annual laments of certain farmers who would make us think that their crops are entirely ruined. As an article we have just read put it, if the wind does not blow all the fruit off the trees, the frost has killed the buds; if the rain does not come at the wrong time and ruin fruit or hay, rodent pests have entirely destroyed certain crops. Several farmers have gone so far as to say that unless relief from the depredations of birds be furnished immediately, they are

ready to give up fruit raising, or whatever the crop might be. Those of us who watch not unconcernedly the crop reports, often wonder at the contrast between the farmers' statements of complete loss and the annual enumeration of wonderful crops reaped, and the statement of the carloads sent to market. Not many years ago the grain growers around Tulare Lake maintained that winter grain had been ruined by geese. An investigation showed that some damage was done, but when the crop reports appeared it was shown that a record yield had been obtained from the same ranches from which the complaints had been made.

Birds are but one factor to be considered in the growing of crops, and the wise farmer, instead of becoming discouraged, will simply be led to seek means of preventing damage. Had we more who would devote themselves to solving the problem, a solution would quickly be found, for it is a sad commentary if man's ingenuity can not outwit any bird that flies.

FOR THE VIOLATORS' CONSIDERATION.

Clarence Johnson of Belmont, who had pleaded guilty recently to a charge preferred by Warden Jack Burke that he had shot a doe accompanied by two little fawns, appeared for sentence.

Judge Johnson explained the law to him and outlined the seriousness of this offense and imposed a fine of $200 or sixty days in jail.

After his impressive remarks to the accused youth, Judge Johnson read the following appropriate and timely lines:

The Fawns.

Little children of nature, your mother is dead,
For the hunter has found her his aim;
And long will you lie on your moss-covered bed
And wait for her coming in vain.

The cougar will scream in the dead of the night,
When the wind is a wail in the pine,
Then trembling you'll call for your mother in fright,
You'll call, but no answer is thine.

Ah, long in the hush of your leaf-circled home
You will wait for your mother's return,
While hunger will feed on your delicate flanks,
And thirst will your tender lips burn.

When the moon is as pale as the face of the dead,
And the hoot of the owl is a moan,
The many green paths where so often she led
You will timidly follow alone.

Sweet children of nature, so helpless, so mild,
Little friends of the shadow and glen—
Oh, had I the power to give you what I took,
I'd return you your mother again.

—Guy Fitch in Outdoor Life.

CANADA ENFORCING MIGRATORY BIRDS CONVENTION ACT.

It will be of interest to those concerned in the protection of birds in the United States to learn that the federal legislation for bird protection in Canada is legally sound.

In this connection we call attention to the recent case of The King *versus* Russel C. Clark. The defendant had in his possession a boat, a gun and fourteen Canada geese, at the time he was apprehended by a migratory bird warden. The case was first tried before a local magistrate and dismissed. An appeal from the dismissal was then taken to the Supreme Court of Prince Edward Island.

The court, in its judgment, points out the fact that the Migratory Birds' Convention Act was passed to give effect to a Treaty for the Protection of Migratory Birds which traverse Canada and the United States, the title whereof is not considered vested in any particular part of either country. It was further stated by the court that "the Canada goose is indisputably a migratory bird traversing the continent of America from the frozen north to the Gulf of Mexico and that it is only at certain seasons to be found in any particular part thereof."

The magistrate's order for dismissal was set aside and the appeal allowed with costs. Under this decision Mr. Clark's gun was forfeited and a fine of $10 was imposed in addition to the costs of court.

This case has attracted wide attention among naturalists, sportsmen and all who are interested in the conservation of wild life on the continent, and it is a source of much satisfaction to note this favorable outcome of a test case which assures the legality of Canada's enforcement act.

ADDITIONAL PROTECTION FOR MULE DEER DEMANDED.

With the coming of the automobile and good roads, the large mule deer of northeastern California is being greatly reduced in numbers. During the past season it was estimated that 900 machines containing hunters visited Modoc and Siskiyou counties. The license plates showed that they came from Oregon and Washington as well as from California. Many of these hunters obtained the full limit—two bucks—which shows that a very heavy toll was taken. It is the opinion of many hunters of this region that the mule deer will not be able to withstand such concentrated hunting and a sentiment is growing which favors either the closing of the season on this species for at least three years, thus giving them time to recuperate, or the establishment of a limit of one buck.

DOES THE DOVE SEASON OPEN TOO EARLY?

If we recognize the fundamental conservation law which states that birds and mammals must be protected during the breeding season, there is no doubt but that the dove season for many years opened too early, and many hunters believe that it still opens too early, allowing the killing of birds which are still feeding their young. In this connection the following two letters are of interest:

"I wish a change could be made here in this district (District 4) on the opening of the dove season. It is too early by one month. Both last season and this I found nests with just hatched birds, August 18 to 20."—Chas. F. Schnack, Escondido, California.

"Yesterday, September 12, I visited a friend who lives near Camanche, or about eight miles from Ione. I went there to have a dove shoot, but in going through my friend's orchard I found nest after nest of young doves not yet good squabs. We counted probably thirty such young broods; then I stuck my gun in the case and quit. This is to suggest that the open season should be one month later."—Frank E. Covey, Stockton, California.

Not only does an early opening of the season endanger the mourning dove, but it often accounts for "soonering" on quail.

TRINITY COUNTY BACKS GAME LAWS.

As a result of the strict enforcement of the law in Trinity County during the earlier part of this season, there have been fewer violations of the game law this year than for several years past. The fine for hunting without a license has been raised to $25; one violator who merely attempted to kill a deer was confined in jail for ten days, while another who was unable to put up $500 bail was compelled to remain in jail for 17 days awaiting his trial. The success of this policy is evident from the small number of deer killed this year.—G. O. Laws, Douglas City, California.

A QUOTATION FROM EARLY CALIFORNIA HISTORY.

From "A Natural and Civil History of California," written by Miguel Venegas, in 1758, we quote an interesting discourse on the brown pelican. Venegas was one of our earliest California explorers. He gives many quaint descriptions containing ideas which are questionable when exposed to present day knowledge.

Venegas, quoting from Father Torquemada a list of birds found about the harbor of "Monte-Ray," continues as follows: "The same author says that in the island of Assumpcion they saw great numbers of a peculiar species of gulls, which, as they are found in several parts of California, it may not be improper to insert here the description of them by Friar Antonio della Assumpcion."

The gulls live on pilchard and other small fishes; but they are equal to a very large goose in size, their bill a foot in length, and their long legs resemble those of a stork; their beak and feet are like those of a goose. They have a vast craw, which in some hangs down like the leather bottles used in Peru for carrying water; and in it they put their captures to carry them to their young ones. The friendly disposition of these birds is something surprising, for they assist one another, as if they had an unadulterated use of reason. If any one is sick, weak, maimed, or otherwise disabled from going in quest of food, he is plentifully assisted by others, who lay it before him; of this I, myself, was an eye witness in the island of San Roque, where I accidentally found a gull tied with a string, and one of its wings broken; around this maimed bird lay heaps of excellent pilchards, brought thither by its companions; and this I found was a strategem practised by the Indians, to procure themselves a dish of fish; for they lie concealed, while gulls bring these charitable supplies; and when they think that little more is to be expected, they seize upon the contributions.

"Such are the mysterious ways of providence for the support of his creatures."

BLACKBIRDS DAMAGE GRAIN IN IMPERIAL VALLEY.

Mr. F. E. Garlough, an investigator for the United States Department of Agriculture, has recently reported that blackbirds have been very destructive to growing grain in the Calipatria district of the Imperial Valley. Ranchers interviewed reported considerable sums of money expended for ammunition and labor in an attempt to protect their crops. One rancher estimated his expense at four hundred dollars, another at one hundred and thirty-three dollars, and a third at one hundred and seventeen dollars. In addition to a large resident blackbird population, the number is greatly augmented by migrants from the Great Basin, which spend the winter in the valley. The problem is, therefore, likely to continue a serious one.

ALASKA SALMON FISHERY.

On October 26, 1921, a conference was called in Washington by Secretary of Commerce Hoover, to consider the condition of the Alaska salmon industry and the steps to be taken to perpetuate the salmon supply.

The consensus of opinion at the conference was that there has been overfishing of the salmon waters of Alaska; that under the existing law the further depletion of the salmon supply can not be prevented, and that the industry is faced with eventual extinction unless some radical action is taken. It was urged that Congress should at once give full and broad authority to the Secretary of Commerce to regulate fishing in all waters of Alaska over which the United States has jurisdiction, and it is noteworthy that the fishing interests assembled, representing practically 80 per cent of the volume of the salmon canning industry of Alaska, were, with a single exception, unanimous in advocating the bestowal on the Secretary of Commerce of full power and responsibility for upbuilding and preserving the salmon supply.

ALASKA SALMON INVESTIGATIONS.

Dr. Charles H. Gilbert and Field Assistant Henry O'Malley returned from an extensive trip to Alaska, which was devoted to a study of the runs of salmon in the southeastern and central districts. Special attention was given to the salmon of Kodiak Island, where a rack had been constructed in Karluk River early in the season and the counting of red salmon ascending the stream was being carried on. It is reported that up to September 17 the total escapement of red salmon up the river was 1,322,000. Dr. Gilbert advises that the investigations in the Karluk region were most interesting and profitable. Every spawning stream tributary to Karluk Lake was examined, and upward of 1,000,000 red salmon were observed on the very limited spawning grounds of that district. The escapement for spawning as related to the commercial catch, a subject which the bureau has under consideration at Karluk and Litnik in Alaska, as well as at Quinault Lake and Baker Lake in Washington, is receiving merited attention from the fishing interests. It is the purpose to continue the work in these fields and to extend the experiments to other favorable streams.—Fisheries Service Bull. No. 77, p. 3.

OIL POLLUTION.

The pollution of waters by oil from refineries and its consequent destruction of fish and bird life, has attracted attention the world over. At a recent conference in Washington, over pending legislation in Congress, the side of the oil interests was emphasized by oil men present. According to their statement, the bills now pending in Congress are discriminatory in that they single out oil interests for special legislation. In reality, oil is but one form of water pollution now affecting the fisheries. Fortunately a splendid attitude of cooperation on the part of the oil interests was manifested.

JUSTICE TO GAME WARDENS.

The work of the game warden, when well performed, should earn for him not merely the small recognition of moderate pay, but in addition to this the honor due to faithful service, the hearty cooperation of those who derive the greatest benefit from his strenuous, often hazardous toil. A complete list of the game wardens killed and wounded in the performance of their duties would bring to the public greater realization of the dangerous nature of the daily routine of a class of men too often reviled instead of rewarded—the yearly

honor roll of those who have made the supreme sacrifice passing into oblivion, while the negligence of the few appears to be blazoned forever by detractors desiring to discredit the game warden system. The great injustice of this is evident.

If every state in the Union could boast perfect laws for the proper protection of game and fish—the federal protective law equally perfect—these restrictions would be nothing more than the proverbial "dead letter" on the statute books without means of enforcement. Laws are inoperative if not enforced, and this applies particularly to those legislative enactments which are not fully in accord with the wishes of nearly all concerned. Game laws are still regarded in the light of so-called class legislation by so many men failing to grasp or admit the beneficent purpose that the need of good wardens, faithful and fearless enough to risk their lives in devotion to duty, must be admitted by all unprejudiced observers. As brave public servants they deserve and should receive support.

In few other, if any, branches of state employment does the expense of officials engaged in the work fall almost entirely upon the class supposed to benefit mainly through enforcement of a law. The gun license system has become so general throughout the entire nation that the proceeds in each state serve to pay the game wardens, and in some instances a portion of the revenue derived is even diverted to other interests, where the powers that be ignore the purpose of the fund—the evident if not always clearly specified principle governing its expenditure. To this extent the sportsmen of the land are doing their full share, but the moral obligation of active aid in the cause of conservation should never be ignored. Sportsmanship stands upon a broader basis than passive approval of good game laws and the work of good game wardens.

The direct, pecuniary benefit derived from strict enforcement of the game laws naturally falls to the farmer. The sportsman has his pleasure, for which he pays liberally in the expense incurred, while the tiller of the soil—the fields where Bob White has happy habitat—finds reward in relief from insect pests injurious to growing crops, with the clear whistle of the birds to lighten his own day labors. The clear-sighted granger should realize and appreciate alike the work of the wardens and the fees of the license-paying sportsmen, which combine to make the game laws effective, thus—with the farmer's hearty cooperation—forming a sort of invincible triumvirate guarding against annihilation of game birds in general and that universal favorite, the quail, in particular.—*American Field*, November 26, 1921, page 1.

GOVERNMENT HUNTERS KILL MANY PREDATORY ANIMALS.

Since 1915, when Uncle Sam turned hunter of wild animals that roam the western ranges and prey on the farmers' live stock, he has accumulated a game bag the like of which was never before witnessed in history, according to reports to the Biological Survey, United States Department of Agriculture, just made public.

By trap and gun the government hunters have killed a total of 156,150 predatory wild animals. That period represents the time of government activity in that kind of work.

During the fiscal year 1921 figures show the total number of predatory animals killed was 27,637, classified as follows: 89 bears, 2468 bobcats and lynxes, 24,258 coyotes, 128 mountain lions, and 594 wolves. The average destruction by these animals is estimated to be, for each wolf and mountain lion, about $1,000 worth of live stock; each coyote and bobcat, $50 worth; and each stock-killing bear, $500 worth.

SALE OF GOVERNMENT FURS.

A public auction sale of 10,087 dressed, dyed, and machined Alaska fur-seal skins and 1125 blue and 14 white fox skins from the Pribilof Islands was held at St. Louis, September 28, 1921, by the Fouke Fur Company, the department's selling agents. A considerable number of low grade skins included in the offering of fur-seal pelts brought the average price per skin down to $32.99, the total gross price bid being $333,924. Prices obtained were approximately 7½ per cent lower than the next preceding sale in May, 1921. The blue foxes sold averaged $96.83 per skin, an average advance of about 20 per cent over the prices received at the preceding sale in February, 1921. The total amount bid for fox skins was $100,398.—Fisheries Service Bull. No. 7, p. 4.

GAME SHIPMENTS MUST BE LABELED.

The Bureau of Biological Survey, United States Department of Agriculture, calls attention to the fact that under federal law all packages in which wild ducks, geese, and other migratory game birds are transported, must have the name of the shipper and of the consignee and an accurate statement of the numbers and kinds of birds contained therein clearly and conspicuously marked on the outside thereof. Sportsmen shipping game birds without proper markings are liable to prosecution in the federal court and the birds to seizure and condemnation.

THE FRESH WATER MUSSEL A PARASITE ON FISH.

A recent publication of the United States Bureau of Fisheries (Document 893, pp. 1–181), details the life history and habits of the fresh water mussels of the Mississippi and Great Lakes drainages. That the work is timely is evident when it is known that the continual demand for these mussels for food and for the making of pearl buttons has brought about a need for careful conservation. A knowledge of the life history is the first need, when planning suitable protective legislation.

Outstanding in the life history of the fresh water mussels is the fact that in the larval stage they are parasitic on fish. The larval form, designated as glochidium, when completely developed and ready to emerge from the egg membrane, is a soft mass of flesh with neither gills nor foot, but with a thin shell composed of two parts like the bowls of tiny spoons, hinged together at the top. The number of glochidia born in the brood pouches of fully grown female mussels varies in the different species, from 75,000 to 3,000,000. If the glochidium matures its continued development is dependent upon its coming in contact with the gills or fins of a suitable fish host, and attaching to them. If it fails to make this attachment it dies within a few days' time. This is apparently true of all but two of the fresh water mussels. The larval mussel attaches itself by firmly clamping its valves to the tissues of the host. A certain portion of the tissue of the fish thus becomes inclosed and this quickly disintegrates and is consumed as food. The attachment causes tissues of the host to grow rapidly until the larval mussel is completely enclosed within a protective covering known as a cyst. After the period of incystment the mussel has attained a sufficient development to begin an independent life and to care for itself. Duration of the parasitic period may last from ten days to two or three months.

Twenty-six different species of fish are known to act as hosts to the developing mussels. Among them are such well known fish as the bullhead, yellow cat, small mouth and large mouth bass, yellow perch, crappie and striped bass.

The fact that fresh water mussels are dependent upon fish for existence during part of their lives emphasizes the fact that the conservation of the fishes is just as important to the preservation of the fresh water mussel resources as is the propagation and protection of the mussels themselves. "The disappearance or radical diminution in number of certain species of fish would result in the complete or virtual disappearance of corresponding species of mussels. On the other hand, as the growth of mussels in more or less dense beds produces conditions which are favorable to the growth of fish food—and observations do so indicate—then the disappearance of the fresh water mussels would result in the diminution of the food supply for fishes and the conservation of mussels is important for the preservation of our resources in fish."

LIMIT ON HUNTING LICENSES ADVOCATED TO CONSERVE BIG GAME.

During the hunting season last year more than 5,000,000 persons, estimates the Biological Survey of the United States Department of Agriculture, went out with guns into the woods and fields of America. Their going emphasizes the growing need of more adequate and uniform laws to conserve and protect the country's dwindling game supply.

"It has been the practice in many states," the department says, "to issue hunting licenses for the open season to all applicants, with too little regard for the available game supply of any particular area. The hunters may far outnumber the animals hunted within a given section, and under such conditions the extinction of big game especially is inevitable.

"The Department of Agriculture advocates a limited license plan for big game, based on annual estimates of game conditions in each district. This means that the number of big game licenses issued for a given area in one season would depend upon the number of game animals which it has been determined in advance can be spared. Proper administration of this sort should conserve game in the greatest numbers consistent with the reasonable demands for local grazing and other interests and obviate the necessity for establishing perennial closed seasons, except on areas being restocked."

DEER CONDITIONS IN THE TRINITY REFUGE.

For the past two years I have been filling the position of fire observer in the lookout on Bally Mountain, and being greatly interested in wild animals and their life history, I undertook a study of deer and their habits. Bally Mountain is situated practically in the center of Fish and Game District 1D. The Indian name for this mountain is "Lolcha Bola," meaning in English "Ghost Mountain." The Indians never hunted game on this mountain, as they were superstitious and believed in ghosts.

The south slope of the mountain is very steep and rough and is covered with various types of brush on which deer feed. The north and east slopes are covered with heavy timber and the does and smaller deer seem to stay on this side, going over to the south side mornings and evenings to feed.

I salted the deer both seasons near the station. The first two months of the season, July and August, does, bucks and fawns could be seen together at the salt logs in considerable numbers. In September and October I noticed a decrease in the number of bucks going to the salt logs, but the does and fawns continued going until I left, October 26.

I noticed a number of deer of different color. A cream colored and a red buck seemed to travel together. I saw them every few days in 1920 and 1921. I also observed a buck with a white head and neck, and one with a split ear hanging down on the side of his head. The does and smaller deer visited the salt logs more regularly than the bucks. A doe that had three fawns stayed near the lookout all during the summer of 1921. Many of the deer became very tame and hardly ever were frightened away. They were often near the Aladade map table and flag station, sometimes within fifty feet while I worked on the map. However, good pictures were hard to obtain on account of the dense brush.

My record of the deer seen in 1920 was 3276. In 1921, 3673 were observed, making an increase of 397 for 1921. Doubtless the same animals were counted many times.—Elsie R. Luckie, Hayfork, California.

IS THE DOVE BAG LIMIT TOO LARGE?

Are bag limits too large? They are. Fifteen doves are more than one man needs in one day. Most sportsmen would be, and all hunters should be satisfied with a bag limit of eight or ten dove, quail, or duck. If the bag limit on dove is not reduced and hunters persist in shooting them when they are coming to water or potting them while they are sitting on telephone wires and in trees, we will not have long to wait until the curtain is drawn on dove hunting.

Nature has been kind to the doves this year in southern California. Heretofore dove weed grew only in small patches along bean fields and dry washes. This year whole fields and even ranches are literally covered with the tidbit of the doves. This fact has helped to keep the birds more scattered and harder to hunt, yet there were over a thousand limits reported in Los Angeles the opening day of the season.

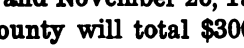
While hunting doves the second day of the season I saw three hunters shoot at a bird in succession, each missing it clean. The dove flew down the canyon and passed me at about forty yards distance. I fired once and missed. Instead of flying on out of range the dove banked sharply and landed right in front of me and began to eat. I noticed then that the dove was almost pure white. There were no spots on his back or neck. His wings and back were just a little darker than the breast. I walked closer to him hoping to get a better idea of his size and color but he flew away with that peculiar whistle of a mourning dove. I will add that the three hunters shot at him again as he darted over their heads; with the same good luck he flew on unscathed.—Edgar K. Lipking, Sawtelle, California.

FACTS OF CURRENT INTEREST.

The gray squirrel appears to be getting scarce in many sections, especially in southern California, and there is increasing demand for additional protection.

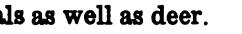
Computation of the salmon catch from January 1 to September 30, 1920, shows a total of 10,777,056 pounds. The catch for the same period in 1921 totaled 7,582,738 pounds, a decrease of 3,194,318 pounds.

That the mountain lion is still found in numbers in certain places in California is evidenced by the fact that J. G. Moore of Los Olivos, Santa Barbara County, recently applied for bounty on eleven lions taken between October 9 and November 26, 1921, in the Santa Barbara National Forest. The bounty will total $300.



A spoonbill duck apparently banded in Manitoba by the Mercantile Company was recently killed by a hunter on the Salton Sea in Imperial County, California.

Judging by reports from forest officers, the coyote continues to be a serious pest in many sections. This predatory animal attacks sheep and other domestic animals as well as deer.



The band-tailed pigeon appears to be on the increase, for there are many reports to the effect that the birds are breeding in considerable numbers in many sections of the state.

The open season on waterfowl has furnished good sport in many sections, but can not be considered extraordinary.

Game law violators have received heavy fines from the judges of the state, minimum fines being $25 and maximum $250. The attitude of the judges is doing much to prevent violations and make enforcement easy.

HATCHERY NOTES.

W. H. SHEBLEY, Editor.

TROUT DISTRIBUTION, 1921.

The distribution season at the state hatcheries was closed on November 18, when the last fry from Mount Whitney Hatchery were delivered to the Bishop Chamber of Commerce for the streams of Inyo and Mono counties situated north of Bishop.

The total output of trout fry from the different hatcheries for the season of 1921 was approximately 24,500,000. At this date all reports are not in.

The output from the different hatcheries was as follows:

Mount Shasta	12,500,000
Fall Creek	650,000
Mount Whitney	2,300,000
Fort Seward	1,200,000
Lake Tahoe	1,000,000
Mount Tallac	900,000
Ukiah	550,000
Snow Mountain	160,000
Brookdale	900,000
Domingo Springs	550,000
Clear Creek	350,000
Feather River	800,000
North Creek	1,000,000
Bear Lake	1,200,000
Wawona	400,000
Kaweah	400,000

With the exception of two or three minor cases where a few thousand were affected, all of the fry were reared without any epidemics. Prompt action and efficacious treatments in these instances soon put them in good condition. Especial care was used in planting the fry to see that they were planted in suitable waters and given a wide distribution.

The demand for trout fry was greater this season than at any time in the history of the state, due to the increasing number of anglers and the easy access to the streams and lakes, that has been brought about by the construction of new highways and the increasing use of automobiles. Nearly every stream is fished to its limit. A shorter fishing season will have to be instituted in this state if the people are to continue to enjoy good fishing. The long open season does not give the fry planted a chance to grow before they are caught out.

In every section of the state there has been a demand for more trout fry by resort keepers, chambers of commerce, county boards of supervisors and others who are boosting their different localities. This demand on our hatcheries has been greater than finances and equipment can furnish. If the people insist on increasing the supply of trout fry to supply the great demand made on the waters of this state they must ask the next legislature to increase the angling license or provide other means of revenue to increase the output of the state hatcheries.

Improvements were made at Mount Shasta Hatchery, the Klamath River Egg Collecting stations, Bear Valley Hatchery and the Fort Seward Hatchery. An experimental hatchery was operated near Johnsville, Plumas County, to determine whether the water was suitable for hatchery purposes. The experiments were successful and whenever the funds are available a permanent hatchery will be erected on a site leased from the Plumas-Eureka Mining Company.

A new egg collecting station was built on the South Fork of Eel River, near Branscomb, Mendocino County, in an effort to collect more steelhead trout eggs and to determine whether chinook salmon eggs can be collected in sufficient numbers to furnish the Fort Seward Hatchery with eggs enough to supply fry to maintain the salmon run in the Eel River. Traps were placed in the South Fork of the Eel River, Dutch Charlie Creek and Kinney Creek. Cabins were built for the help at South Fork of Eel River stations and at Kinney Creek. Twenty-five hundred feet of ditch and flume were constructed to furnish the station with an adequate supply of water.

The upper reaches of the South Fork of Eel River near Branscomb is the region in which a great many of the best spawning areas of the river are found. The salmon spawn late in this section, during December, when weather conditions are favorable. This fall the unusually dry period in that section has not been favorable for the movements of the salmon up stream and it may not be possible to determine the number and length of time that the salmon run in the headwaters of the South Fork of Eel River. Plans are being made to collect the steelhead trout in these traps this coming spring.

SALMON DISTRIBUTION, 1921.

During the season of 1921 three millions of salmon fry were reared in the ponds at Mount Shasta Hatchery for distribution in the Sacramento River and two millions of salmon fry were reared in the ponds at Fall Creek Station for distribution in the Klamath River.

The work of collecting salmon eggs at Klamath Station on the Klamath River was finished on November 25. The season was favorable for the salmon to ascend the river and a total of 19,500,000 chinook salmon eggs were collected. This was the largest number of eggs collected during any season since the establishment of the station in 1910. There was still a number of salmon running at the time the station was closed that would have added several million more eggs to the season's take, but limited funds necessitated the stopping of operations in preparation for the collection of the rainbow trout eggs, as the spawning trout were ascending the river to enter the tributary streams.

During the fall and winter of 1920–1921 experiments were made in hatching salmon eggs in a small experimental station in Crane Valley, Madera County, to determine whether the site was suitable for the hatching and rearing of salmon eggs, should it be decided to operate an egg collecting station and hatchery below Power House No. 4 of the San Joaquin Light and Power Company's dam on the San Joaquin River. The San Joaquin Light and Power Company have erected a dam across the San Joaquin River near Aubery over which it is impracticable to construct a fishway. They also divert all the water from the river through a 17,000-foot tunnel, thus drying up during the summer and fall about fourteen miles of the bed of the San Joaquin River, between the dam and Power House No. 4. This prevents the salmon from passing up the river to their former breeding grounds and if the salmon in the San Joaquin River are not to be exterminated a rack and traps must be installed in the river near Friants, so that the eggs may be collected and hatched and the resulting fry released in the San Joaquin River below the dam. Our experiments proved that the location in Crane Valley was not a suitable place for a salmon hatchery.

It is proposed to rack the river near Friants and pump the water from the river for a hatchery supply next season. The expense of building the racks and traps, hatchery, living quarters for the help and equipping the same must be borne by the San Joaquin Light and Power Company, as the law provides that wherever a dam is built over which it is impracticable to construct a fishway for the free passageway of fish, the company or individual owning the same must erect and equip a suitable hatchery and egg collecting station free of charge to the state. An amendment to this law should be made at the next session of the legislature compelling the owners or occupants of such dams to not only construct and equip the hatcheries but to furnish the necessary funds to the Fish and Game Commission to operate the same, as they destroy the natural runs of fish and give the people nothing in return for the fishing interests that they destroy. The sum for operating such stations could be allocated among the different owners of the dams, if there were more than one owner or occupant of dams on any river or stream.

LIFE HISTORY NOTES.

THE OPOSSUM AT EL MONTE, LOS ANGELES COUNTY.

About a month ago, while engaged in flood control work on the Rio Hondo, north of El Monte, Los Angeles County, I noticed some boys carrying a box trap down the river. On stopping them I found they had trapped an opossum. They told me that they had seen another, evidently its mate, in the willows along the river. I could not find out how long the opossum had been in that locality or if more than two had been seen.

Judging from the reports on opossum in the last number of CALIFORNIA FISH AND GAME, the "midnight frolic" of the Old South will eventually come to southern California.—Edgar K. Lipking, Sawtelle, California.

UNIQUE EXPERIENCE WITH MOUNTAIN LION.

A rather unique experience with a mountain lion is told by L. S. Davey, of Usona, Mariposa County, California. Mr. Davey says:

"It was in the month of April, 1898. I had been plowing in my orchard, and had gone to the house for dinner. After dinner I took my rifle and walked about three hundred yards north of the house to a field of barley to kill some ground squirrels, when all at once I heard a small pig begin to squeal and saw the sows rallying together about three hundred yards farther on. As the pig continued to squeal for several seconds, I knew that something was killing it, so I ran across the creek to where the hogs were, and found the sows around the foot of an oak tree, very angry and worked up.

"When I first came up to the tree, the sows showed fight, but moved on up the hill as the pig had stopped squealing. I began looking for signs and found blood scattered on the oak leaves, and while making an examination I noticed blood dropping from the tree. Looking up I saw a mountain lion holding a pig in his mouth and still watching the sows. I raised my rifle and fired, the bullet striking him in the region of the heart. He jumped from the tree, ran about thirty yards, and fell dead."

A somewhat similar incident happened during the past summer when Louis Austin of Grizzly Flat killed a lion which had apparently been treed by sows after the lion had killed a small pig. Frank Barrett of Kingsley, California, vouches for the incident, having arrived on the scene shortly after the lion had been killed.—H. C. Bryant, Berkeley, California.

CAPTURE OF OCEAN SUNFISH OFF CATALINA ISLAND.

In the Zoological Society Bulletin, November, 1920, the capture off Santa Catalina Island, California, of an ocean sunfish (*Mola mola*), is recorded by Mr. Van Campen. An effort was made to harpoon the *Mola* and bring it to Avalon alive, but after a hard struggle it was necessary to shoot the fish before it could be towed in. After landing, a large crowd viewed the fish with much interest. The weight of the sunfish was estimated as about 2000 pounds, the actual measurements being ten feet and eleven inches from tip of snout to end of caudal and ten feet and ten inches in depth from tip of dorsal to tip of anal.

GRAY SQUIRREL DISEASE SPREADING.

The disease (scabies) attacking gray squirrels, described in the April number (p. 128) of CALIFORNIA FISH AND GAME, appears to be spreading throughout northern California, as is evidenced by the following reports of forest officers for 1920:

"Tree squirrels are getting so scarce in the Trinity section of the Shasta National Forest that only one or two are seen on a day's ride. A closed season of five years is recommended for this animal. Some of these animals are affected with some disease. Of four I saw last season, all had it. It seems to be a kind of scab and takes away all their strength, as they are unable to climb or make any time on the ground."—James H. Stone, Sisson, California.

"In the Squaw Creek district of the Shasta National Forest on lower Pit River, the gray squirrel was very abundant up to 1919, when for some reason he almost disappeared. This disappearance might be due to migration or some disease that broke out among them. The latter is thought to be the case."—J. R. Hall, Sisson, California.

"The gray squirrel is generally considered quite valuable as a game animal and is reported as quite numerous in some sections of the Klamath National Forest. It is reported that a disease breaks out every few years among the squirrels on the lower Klamath River, which reduces their number considerably. In instances observed, small red spots appear on the skin; the hair comes out in large patches giving the appearance of mange. Specimens observed have been very emaciated."—B. J. Shannon, Yreka, California.

CONSERVATION IN OTHER STATES.

NEW HUNTING ACCIDENT LAW IN PENNSYLVANIA.

The Pennsylvania legislature has recently passed a law making it a misdemeanor to shoot at, either injuring or killing persons in mistake for game, the penalty being from one to five years imprisonment, with a fine of from $100 to $500. The fine goes to the state unless the shot results in an injury, when the fine goes to the person injured; or, if death results the fine goes to the relatives of the deceased. Every state should have a law of this character which offers needed relief for the not uncommon occurrence of injuries or deaths resulting from the carelessness of sportsmen.—R. P. Holland, *Field and Stream*, 26, p. 501.

PUBLIC SHOOTING GROUNDS FOR OHIO.

Ohio is one of the first states to provide for public shooting grounds by legislation. The legislature of that state recently passed a public shooting ground and game refuge bill which gives the Ohio Bureau of Fish and Game almost unlimited authority in establishing public shooting grounds throughout the state. Ohio will stock her refuges and public shooting grounds with quail, wild turkey and Virginia deer.

OREGON NOTES.

Oregon has purchased the Simpson Game Farm and the Eugene Game Farm and these are now being operated with money furnished by hunting licenses.

The bob-white is on the increase in Oregon, according to the last biennial report of the Oregon Fish and Game Commission.

Oregon demands that the state laws should be made to conform with federal legislation regarding waterfowl. Oregon appears to be one of the last states to make this adjustment.

This state is trying out a scheme of holding steelhead trout in breeding farms at the hatcheries until they are one year old.

HUNGARIAN PARTRIDGE IN WASHINGTON.

A remarkable measure of success has been secured in planting the Hungarian partridge in Spokane County, Washington, and surrounding territory. About sixteen years ago an unsuccessful attempt was made to plant the Hungarian partridge in this district, but the effort made a few years later has proven such a success that sportsmen in Vancouver have also planted the birds with the same satisfactory results. It has even been suggested that the bag limit, which is now five birds per day per gun, may be safely increased within the next few years. The Hungarian seems to do better in this district than in its native habitat, and it is found that the species gives evidence of attaining a larger size than in Hungary. The Hungarian partridge is the native gray-legged partridge of all Europe and the British Isles, and it is significant that in Washington the birds appear to have thriven in the humid coast section as well as in the dry eastern part of the state.—R. P. Holland, *Field and Stream*, 26, p. 295.

NONDRAINAGE OF IOWA LAKES ADVOCATED.

As indicating deep public interest in the subject, it is interesting to notice that in the report of the Iowa State Highway Commission (1920), upon "Iowa Lakes and Lake Beds," retention and improvement of the lakes is recommended in nine-tenths of the cases, thereby adopting a policy of conservation in the interest of the rights of the entire public, as opposed to the policy of the drainage advocates. After a thorough investigation of the damage to crops which it had been claimed was a result of the wild birds which congregate in the vicinity of these lakes, the Commission reached the conclusion that in the relations of lakes, bird pests, and the public, it would be highly preferable that direct control measures be applied to the injurious species rather than that the lakes be drained, for the latter are not only of great value as recreation places but also are the center of abundance of numerous species of wild birds, including valuable game birds entirely dependent upon the presence of the lakes. W. L. McAtee (*Auk* 37, pp. 620–621) points out, however, that in insisting upon the raising of the water level, in order to discourage dense growths

of water lilies, of cattails, rushes, and of marsh as a whole, the report errs in that the marsh is absolutely necessary as a breeding home for practically all the birds which are attracted by the lakes. While saving lakes from drainage is a conservation measure, wild life will suffer practically as much from elimination of marshes as it would from drainage.

WISCONSIN TO RECORD ANNUAL DEER KILL.

An effort is being made this year in Wisconsin to obtain a comprehensive report of the killing of deer within that state. By this report, which will be made up from returns sent in by the hunters throughout the state, it is expected that statistics will be available as to the number of bucks killed, their weight, in what county the most were killed, what days and what time of day most were killed. Such statistics will not only be of great interest to the hunters of Wisconsin but will also be very important as a basis for future legislation.

BIRD PROTECTION IN FLORIDA.

The Florida legislature has again had the subject of conservation of the state's resources presented strongly to it by able advocates, and again has this honorable body turned a deaf ear to those who would have the state appoint game wardens to enforce the now unenforced laws for the protection of wild birds and animals. Florida now is practically the only state in which this unfortunate situation exists. However, it is expected that the matter will be taken up again with increased interest and vigor at the next session of the Florida legislature.—*Bird Lore*, 23 p. 229.

NEW YORK LEGISLATION.

From the one hundred and thirty-five salaried game wardens in the state of New York the force is now reduced to ninety, by the amendments to the game laws of that state which were passed by the last legislature. Since these men have been trained for years for their duties, the change must be regarded as decidedly detrimental to the interests of conservation in the state of New York.

Furthermore, Governor Miller has released George D. Pratt from the position of State Conservation Commissioner. This change is purely political and was not made because of any expressed dissatisfaction regarding Mr. Pratt's administration.

KILLING OF ANTELOPE AND MOOSE IN WYOMING PREVENTED.

At the last session of the Wyoming legislature a bill was passed granting authority to the Game Commission to issue permits, if they thought wise, for the killing of 100 buck antelope and 100 bull moose within the borders of the state. Both of these animals have for some time been absolutely protected. The antelope especially is becoming a very rare animal, in fact, entirely exterminated over large areas of its western range.

The home office of the National Association of Audubon Societies, upon being informed of the pending disaster, instituted a vigorous campaign of protest, as a result of which the permission to issue permits to shoot 100 antelope was withdrawn and the number of bull moose permits reduced to fifty.

FOREST SERVICE COOPERATION.

LARGE ANNUAL KILL OF DEER IN THE SANTA BARBARA NATIONAL FOREST.

Following is a list of the deer killed on or near the Santa Barbara National Forest during the season of 1920:

Santa Barbara County	119
San Luis Obispo County (Kern County included)	65
Ventura County (Los Angeles County included)	164
Monterey County	513
Total	861

There was a total of 978 reported last year, which would tend to indicate that hunting was not being carried on as formerly, or else that deer are becoming scarcer. However, from our observations the woods were full of hunters and it is known that more deer were killed than we were able to get a record of. This, along with information obtained from forest users, indicates that the deer are just about holding their own against the hunters and lions, with a probable increase in some localities.—Thomas W. Sloan, Santa Barbara, California.

COYOTE BOUNTIES IN TRINITY COUNTY.

The report of bounties paid out for the year 1920 by the county treasury shows that $1,323 was paid on coyotes. Of this amount $1,080 was paid for coyotes taken during the winter months when trappers were taking them for fur, and $243 was paid during the summer months, showing that one-fifth of the coyotes were killed during the summer for the reason that there was no fur value so far as dollars and cents go.—Alva Tracy, Knob, Trinity County, California.

DEER PROTECTION IN TRINITY NATIONAL FOREST.

A buck is lawful game at the age of two years. However, at that age he is usually still running with the doe and is not acquainted with the tricks and ways of dodging the hunter practiced by his older brother. A common saying among the stockmen is "Anybody can kill a forked-horn but it takes a hunter to get an old smarty." With so many hunters on the ground during the entire open season the "old smarty" is becoming very scarce and if this practice continues a few more years to the extent that it has in the past he will become extinct and the young bucks—the easy prey of the hunter—will be killed off as fast as they become lawful game. This would leave few, if any, besides the yearling or "spike-buck" to propagate the species. The value of a yearling buck can well be compared with a yearling in domestic stock. Under such conditions there would be a much lower percentage of fawns in a very short time, which would necessitate a close season for a period of years to allow the deer to stock up to standard. This would also show that in the past the game protection had been under poor management.

One suggestion I have to offer is a shorter open season, although a far better one is a game refuge covering North and South Yola Bola Mountains and the headwaters of the South Fork of Beegum Creek, South Fork of Cottonwood and Cold Fork creeks. This is a natural breeding and feeding ground.—Alva Tracy, Knob, Trinity County, California.

NEW GAME REFUGE PROPOSED FOR SANTA BARBARA NATIONAL FOREST.

A game refuge is recommended in the Santa Ynez district for a double purpose, namely:

First, to provide for an area into which a number of people go and in which hunting is forbidden, and also into which the game drift from the higher areas. It is felt that a game sanctuary is needed to better protect and perpetuate especially the deer that come down for water into the region covered by the proposed refuge.

Second, within the area covered by the boundaries of the proposed game refuge is what is known as Gibraltar Dam, in the Santa Ynez River, which impounds a large body of water with a surface of about 280 acres and from which the city of Santa Barbara derives its water supply, and it is very much desired by the city of Santa Barbara that everything possible be done to protect the domestic water supply from possible sources of contamination.—Thomas W. Sloan, Santa Barbara, California.

DEER PROTECTION VERSUS DOMESTIC STOCK ON THE CALIFORNIA NATIONAL FOREST.

While the number of deer now on the forest seem to be well provided with feed without materially reducing the capacity for sheep and cattle, it is obvious that with complete protection such as they must eventually get, deer could be increased to the entire capacity of the winter deer range which would include a large amount of summer cattle and sheep range.

Our estimated winter capacity is 635 cattle which would probably be equivalent to 6000 deer. Our estimated summer capacity is 7600 cattle and 50,000 sheep and in addition to this it is estimated that 40,000 deer are getting year-long feed on the forest. Much of the range now used for early grazing is suitable for winter deer range and if no paid permits were issued it is probable that the forest would provide year-long range for 175,000 deer, and in addition the capacity of the private land in cattle and sheep.

The maximum receipts which we can expect from grazing is less than $15,000. If cattle and sheep were excluded from the forest it would work a hardship on 175 permittees who would be forced to go elsewhere for summer feed. On the other hand a comparatively small area of the country at large comprising the area best suited to the purpose would be devoted to the perpetuation through use of a valuable, natural, public resource. No restrictions other than those imposed by the state game laws would be placed on the taking by the public of the mature bucks, of which from twenty-five to thirty thousand could be killed annually without danger to the breeding stock.

Roads and trails would be improved and the local communities would be benefited by the money spent by thousands of visitors for horse hire, guides and supplies. We have a record of 1000 deer killed during the past season (1920) and it is very probable that as many more were killed and not reported. These 2000 deer should average 75 pounds of dressed meat each which, compared to beef prices, should be worth 30 cents per pound, $22.50 per deer, 2000 deer $45,000. Add to this the healthful exercise, pleasure and self-satisfaction of over a thousand successful hunters, multiply all by ten and you gain an idea of the value and possibilities of the suggestion.—B. H. Mace, Willows, California.

ELK INCREASE IN KLAMATH NATIONAL FOREST.

There is a herd of five elk on Scott River in the Klamath National Forest and one has occasionally been seen on Salmon River watershed. These are unquestionably the original herd of three that were liberated in this vicinity about five years ago. They are apparently in good shape and doing well. This sufficiently demonstrates that this region is adapted to elk. The habits, range and food are practically the same as those of the black-tailed deer. —B. J. Shannon, Yreka, California.

SAGEY TASTE MAY BE REMOVED FROM SAGE HENS.

Sage hen, or sage grouse, as it is sometimes called, is the leading game bird of the Modoc National Forest. This grouse is very plentiful and a splendid game bird. The season should open fifteen to thirty days earlier and close that much sooner since it is impossible to distinguish between young and old birds on the wing and the old birds are often thrown away by the hunters. Sportsmen claim that the old birds are tough and sagey in taste, although personally I believe the sage taste permeates the meat after the bird is killed. I have found that if the craw is removed immediately after killing and the meat soaked for a few hours in cold salt water before being cooked that there is no appreciable difference between young and old birds. Supervisor Durbin also a few years ago ate sage hen almost daily for a couple of weeks handled in this manner and states that practically no sage taste was noticeable. Nevertheless this prejudice exists in the minds of at least ninety per cent of sage hen hunters, including many of our own forest officers.—Wm. S. Brown, Alturas, California.

BAND-TAILED PIGEONS ABUNDANT IN PLUMAS NATIONAL FOREST.

Wild pigeons are found on the southern half of the Plumas National Forest. They nest both on the ground and in trees or bushes and lay from one to two eggs. I found a nest during the middle of September with a pigeon in it about half grown. This nest was built in a bunch of alders about eight feet from the ground and consisted of a few small sticks. They feed on berries, pine nuts and acorns. They can usually be found near mineral springs, especially soda and sulphur springs. I noticed an unusually large number of wild pigeons during the past season; a flock near the soda springs at Keddie in December numbered nearly a thousand.—Henry A. Kloppenburg, Quincy, California.

REPORTS.

STATEMENT OF EXPENDITURES.

Period July 1, 1921, to September 30, 1921.

Administration:		
Commissioners	$187 46	
Executive offices	6,384 05	
Printing	141 25	
Research and publicity	1,333 43	
Accident and death claims	11 28	
		$8,057 47
Commercial fish culture and conservation:		
Superintendence	$4,550 50	
Inspection and patrol	7,982 71	
Research	7,891 00	
State laboratory construction	14,034 29	
Statistics	2,104 38	
Market fishing license commissions	110 00	
Propagation and distribution of salmon	10,411 12	
		$47,084 00
Sporting fish culture and conservation:		
Superintendence	$3,947 25	
Printing	235 90	
Prosecutions and allowances (fish cases)	1,840 95	
Angling license commissions	5,104 40	
Fish exhibits	4,418 25	
General patrol, pro rata share—		
San Francisco District (40 per cent)	10,761 26	
Los Angeles District (40 per cent)	3,952 74	
Sacramento District (40 per cent)	8,104 41	
Propagation and distribution of trout	53,452 45	
		$91,820 61
Game conservation:		
Printing	$287 70	
Prosecutions and allowances (game cases)	380 72	
Hunting license commissions	7,006 70	
Mountain lion hunting (and bounties)	1,692 80	
General patrol, pro rata share—		
San Francisco District (60 per cent)	16,646 39	
Los Angeles District (60 per cent)	5,931 13	
Sacramento District (60 per cent)	12,116 31	
		$44,061 75
Tahoe camping ground		633 05
Grand total		$191,656 88

CALIFORNIA FRESH FISHERY PRODUCTS FOR MONTHS OF JULY, AUGUST AND SEPTEMBER, 1921.

Compiled by Fish and Game Commission, Department of Commercial Fisheries.

Species of fish	Del Norte, Humboldt	Mendocino, Sonoma, Lake	Marin	Solano, Yolo	Sacramento, San Joaquin	Contra Costa, Alameda	San Francisco, San Mateo	Santa Cruz	Monterey	San Luis Obispo, Santa Barbara, Ventura	Los Angeles	Orange	San Diego	Total	Mexican, brought into California
Albacore*											10,977,325	6,753	3,767,150	14,751,228	2,199
Anchovies							82,690		980,477		950			1,064,117	
Barracuda										88,758	684,126	2,006	105,084	879,974	83,969
Bluefish							86	1,981	17,665					19,732	
Boccaccio							13,104	14,601	95,265	282				123,252	
Bonito								280	16	6,951	62,147	395	13,351	82,240	2,800
Carp				103	792	10,212								11,107	
Catfish		2,283			291									2,574	
Chilipepper							1,370	6,834	650					8,854	
Cultus Cod	3,382	13,231	669				136,065	5,172	16,541					175,060	
Dolphin															
Eels															
Flounders				72		586	77,549	7,250	299	1,850	1,408			89,014	
Grayfish						683	25,930				2,602		26,360	55,575	
Greenfish															
Hake							29,495	1,425						30,920	
Halibut	17,450	46,535	2,041				50,331	341	5,075	39,378	96,134	13,177	282,578	553,040	560,588
Hardhead															
Herring															
Kingfish							5,466	5,912	1,085	1,400	7,202		345	21,410	50
[illegible]el								298	191,309	40,518	428,097	8,032	60,279	728,533	1,194
													2,602	2,602	
	867	279,071	615		18	122	8,530		3,928	20	17,908	450	2,810	35,128	
														140	
							250	1		5	711			967	65
										285	101,156	14,905	19,314	135,660	700
	6,003	6,895	20				341,482	52,316	173,019	10,952	102,812	13,451	81,410	788,360	3,775
							117,926	180,971	330					299,227	
	785,174	1,090,491		485,398		731,035	693,897	6,112	5,835					4,077,013	
							186,651	14,450	2,227		2,502			205,830	
							58,390	2,715,689	12,210,626	4,500	15,185	1,207	180,199	13,185,796	
											4,153		183	4,336	
k,										928	8,399		6,398	15,725	3,478
e			8,785			280	16,182	13,419	554	38,317	552,045	3,365	99,959	732,906	192,423
							30			800	27	834	387	2,078	
				46	29	17,159	31							17,265	
				60		102								232	

Smelt	19,736		927				12,600	50,571	51,966	23,891	23,079	19,813	4,174	206,747	1,184
Sole	10	53					1,312,440	115,945	6,885	1,370	1,036	50		1,437,798	
Splittail															
Striped Bass			180	719	942	42,399	38,883							83,123	
Stingaree															
Suckers															
Surf Fish															
Swordfish											13,288		450	13,738	
Tomcod							11,609	375						11,984	
Trout—Farm															
Trout—Steelhead															
Tuna										26	360,215	5,935	798,433	1,164,609	8,738
Tuna—Bluefin											1,829,328			1,829,328	
Tuna—Yellowfin											1,172,916			1,172,916	
Turbot															
Whitefish			116				1,343							1,459	
Whitefish										420	1,525		610	2,555	
Yellowtail										7,430	470,047	5,520	266,222	749,219	30,902
Miscellaneous	14					1,469	20,347	4,009	989 796	898	15,168	511		1,032,212	
Crushers											2,076	8		2,084	
Total fish	832,626	1,159,488	13,353	486,398	281,143	804,107	3,247,117	3,201,982	14,753,576	268,169	17,311,443	96,580	6,439,284	48,895,266	892,205
Crustaceans:															
Crabs (doz.)	200						796							996	
Ecrevisse (doz.)															
Shrimps						73,194	219,405							292,599	
Spiny Lobsters															
Mollusks:															
Abalones	180								537,619	1,056				538,855	
Clams—Cockle	70	16	1,798											1,884	
Clams—Mixed	1,430		7,271			820								9,521	
Clams—Pismo										54,403				54,403	
Clams—Softshell	390	702	14,500			26,533	12,017							54,142	
Cuttlefish							1,825	812	3,512					6,149	
Limpets															
Mussels						73	26		2,875					2,974	
Oysters—Eastern (No.)			595,757											595,757	
Oysters—Native			220											220	
Snails															
Squid									32,643		1,205			33,848	
Miscellaneous:															
Frogs (doz.)															
Terrapins (doz.)															
Turtles															

All amounts shown in pounds unless otherwise specified. *Albacore and Skipjack cleaned. All other fish in round.

VIOLATIONS OF FISH AND GAME LAWS.

July 1 to September 30, 1921.

Offense	Number of arrests	Fines imposed
Game.		
Hunting without a license	26	$650 00
Hunting in refuges	5	80 00
Hunting on posted ground	1	25 00
Alien hunting with citizen's license	1	50 00
False statement to secure license	1	25 00
Deer—closed season—killing or possession	5	175 00
Does, spike bucks, fawns—hunting, killing or possession	35	1,775 00
Deer meat—closed season—possession	14	325 00
Bear meat—closed season—possession	2	25 00
Rabbits: cottontail, brush—closed season—killing or possession	21	470 00
Tree squirrel—closed season—possession	1	50 00
Quail and pigeons—closed season—possession	19	725 00
Doves—closed season—possession or killing—excess limit	20	500 00
Ducks—closed season—possession	6	140 00
Birds: non-game—closed season—possession	7	145 00
Birds: game—in captivity without permit	1	25 00
Chinese pheasant, sage-hen, rail—closed season—possession	3	80 00
Shooting game from automobile	6	80 00
Failure to keep head or horns in possession	14	350 00
Hides, illegal—possession	2	125 00
Total game violations	190	$5,977 00
Fish.		
Angling without a license	33	$660 00
Fishing for profit without a license	17	110 00
Abalone—possession—undersized	14	335 00
Bass: black, striped—spearing—excess limit—undersized	14	345 00
Barracuda—undersized—shipping	1	25 00
Clams—possession—undersized—over limit—closed season	33	1,100 00
Crabs—possession—undersized—shipping	3	25 00
Halibut—possession—undersized	1	25 00
Lobsters—possession—undersized—closed season	6	345 00
Salmon—possession—spearing—over limit	2	125 00
Sturgeon—possession	1	25 00
Using explosives for killing fish and obstruction of stream for taking fish	2	50 00
Total fish violations	132	$3,560 00
Grand total fish and game violations	322	$9,537 50

SEIZURES.

Fish and Game, and Illegally Used Fishing Apparatus.

Game.		Fish.	
Bear meat	10 pounds	Abalone	942
Deer meat	515 pounds	Black bass	34
Deer	6	Striped bass	190 pounds
Spike buck	1	Barracuda	130 pounds
Spike buck head	1	Clams (Pismo)	504
Ducks	128	Crabs	25 doz.
Doe	1	Crabs	47
Doves	23	Crappie	22
Deer skin	1	Eels	15
Meadow lark	1	Lobsters	32
Mocking birds	6	Lobsters	170 pounds
Non-game birds	3	Salmon	18
Pheasants	4	Salmon	100 pounds
Quail	27	Sturgeon	225 pounds
Rabbits	23	Trout	1
Sage-hen	1	Yellow fin croaker	2,200 pounds
Woodpecker	1	Illegal nets	7
		Searches	30

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CALIFORNIA FISH AND GAME

"CONSERVATION OF WILD LIFE THROUGH EDUCATION"

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A HISTORY OF FISHCULTURAL OPERATIONS IN CALIFORNIA.

By W. H. SHEBLEY, in charge Department of Fisheculture.

The California Fish Commission was created by an act of the legislature, entitled "An act to provide for the restoration and preservation of fish in the waters of the state," approved April 2, 1870.

The United States Commission of Fish and Fisheries was established by joint resolutions of Congress, approved February 9, 1871. California, therefore, had an organized fish commission nearly a year before the federal government took up the work of multiplying the food fishes and thereby increasing the food resources of the United States.

The object of the first endeavors of the California Fish Commission was the introduction and acclimatization of new species of food and game fishes. As eggs could be obtained more easily than adult fish, suitable hatcheries for the hatching of eggs became a necessity.

ACCLIMATIZATION SOCIETY HATCHERY.

The California Acclimatization Society, under the supervision of Mr. J. G. Woodbury, first began experimenting, and had made several successful hatches of eggs introduced from the Eastern states previous to the establishment of a state fish commission. A small hatchery, situated near the City Hall in San Francisco, was utilized in this pioneer work.

STATE HATCHING HOUSE AT BERKELEY.

The first hatchery owned and operated by the state was situated on the grounds of the State University at Berkeley. Up to 1873 the Acclimatization Society actually operated this hatchery and was paid by the Fish Commission for the trout reared.

CLEAR LAKE EXPERIMENTAL HATCHERY.

In the early seventies, also, a temporary station was operated on Kelsey Creek, tributary to Clear Lake, for the purpose of hatching a shipment of whitefish sent to the California commission by the United

FIG. 32. United States Fish Hatchery at Baird, Shasta County, in July, 1882. This was for many years the most important salmon-egg collecting station in California.

States Fish Commission. Eastern brook trout, landlocked salmon and whitefish, as well as the native varieties, were propagated with some success, but the location was not suitable for carrying on the work on a large scale.

BAIRD HATCHERY.

The circumstances surrounding the establishment of the first salmon hatchery are as follows: In 1872 the United States commission instructed Dr. Livingston Stone to proceed to the Pacific Coast and there obtain a supply of salmon eggs from the Pacific salmon. Dr. Stone was at that time one of the recognized authorities on fishculture in the United States. He had been engaged in the work of fishculture

for a number of years in New Hampshire and other Eastern states, was a man of education and a close observer of all things in nature. Dr. Stone arrived in San Francisco in August, 1872. He could gain no reliable information regarding the habits of the Chinook salmon or where they spawned. A general impression prevailed that the spawning grounds were near the confluence of the Sacramento and San Joaquin rivers, but after an investigation of this region Dr. Stone concluded that the fish spawned elsewhere. Mr. Montague, chief engineer of the Southern Pacific Company, informed Dr. Stone that he had seen salmon spawning at the junction of the McCloud and the Pit rivers. At that time the terminus of the railroad was at Red Bluff, fifty miles from the spawning grounds on the McCloud River. Dr. Stone was accompanied on his trip to this section by Mr. John G. Woodbury, who had been in the employ of both the California Acclimatization Society and the California Fish Commission.

After many hardships and struggles to obtain material and supplies, they succeeded in establishing on the McCloud River the first salmon-breeding station on the Pacific Coast, naming it Baird, in honor of Spencer F. Baird, Commissioner of Fisheries. The summer run of salmon was nearly over and, judging from Dr. Stone's report, the salmon run in the Sacramento River was very much depleted. From the advent of the whites up to this time, there had been a great demand on the salmon of the Sacramento River; and with no hatcheries to increase their numbers, no adequate laws to protect the breeding fish (and with the great spawning grounds of the Feather, Yuba, Bear and American rivers destroyed by the mining operations on their head-waters), in a few years little was left of the great run of fish that had previously entered these waters. The salmon had abandoned them altogether, as the eggs deposited on the spawning grounds in these streams did not hatch, being destroyed by the detritus from the mines. The only natural spawning grounds left to the salmon were in the tributary rivers that formed the headwaters of the Sacramento River, the principal streams being Mill Creek, Battle Creek, Pit River and its tributaries, Hat Creek and the McCloud River, and the main Sacramento River, above the mouth of the Pit. These proved to be good salmon streams, but the great drain on the salmon and the destruction of nearly one-half of the spawning beds, soon greatly diminished their numbers.

The first season's operations on the McCloud River, by Dr. Livingston Stone and his assistants, were experimental to a great extent. Only 50,000 eggs were taken, and of this number but 30,000 were fit to ship when they had developed to the proper stage. The eggs were shipped to a hatchery in New Jersey and 7000 hatched; and on the advice of several state commissioners and fishculturists the fry were planted in the Susquehanna River. The following season the Baird Hatchery was enlarged and the work of collecting and hatching salmon eggs was begun in earnest. From 2,000,000 to 14,000,000 eggs were taken annually at this station from 1872 to 1883.

In 1881 the plant was destroyed by a freshet, but was immediately rebuilt. The California Fish Commission assisted in the work at Baird by paying a portion of the operating expenses, and in return received eggs for hatching and fry for planting. The main object of this

hatchery for the first few years was to secure eggs to ship to the East for the purpose of introducing Pacific salmon in the waters of that section. The commission early made an agreement with the State of California, however, under which the latter at first paid part of the expense, while the commission hatched and planted a portion of the take in the McCloud River. Later, part of the eggs were turned over to the state, which hatched and planted the salmon in local waters.

About 25 per cent of the total number of eggs taken during this time were hatched at this station, and the fry each season were liberated in the McCloud River, under the supervision of Dr. Stone, superintendent of the hatchery. The cost of hatching and planting was borne by the California Fish Commission. The remaining eggs were shipped to the Eastern states and to foreign countries. Shipments of the Chinook salmon were made to the principal countries of Europe and also to Japan and New Zealand.

In 1883 the United States commission quit operations on the McCloud River. Only 1,000,000 eggs had been taken during the season, this being the smallest take in the history of the work on this stream since the preliminary work of 1872. This great falling off in numbers was due largely to the heavy blasting and other operations on the line of the railroad which was then being constructed from Redding northward. The salmon undoubtedly were frightened so that they did not ascend the Sacramento River; besides, a great many were taken by the grading gangs and used in the camps for food. Thousands of trout and salmon were destroyed by powder used by the Chinese and white laborers, of whom there were 9000 camped along the Sacramento River; and while a great many of the fish were used as food, there was wanton destruction in the way they were killed. The same condition existed in 1884, and Superintendent Stone recommended that the station be not operated that season. It remained closed from that date until 1888, the year that the Sisson hatchery was established by the state.

SAN LEANDRO HATCHERY.

Finding the state hatchery house at Berkeley too small for the quantities of fish required to be hatched, as well as lacking in a reliable water supply, a larger hatching house was built on Lake Chabot, on the property of the San Leandro Water Works, near San Leandro, California, in 1878. Here much of the trout work was carried on until the Shebley Hatchery in Nevada County was taken over by the state.

SHEBLEY HATCHERY.

In 1883 the California Fish Commission abandoned the San Leandro Hatchery, located near Lake Chabot in Alameda County, owing to the fact that the water was too warm for successful hatching and rearing to be accomplished during the warmer months of the year; also, the water was not suitable for the propagation of healthy fry.

A site was selected in Nevada County on the ranch of Mr. J. V. Shebley, who donated to the state the use of the site and the water for hatchery purposes. The first superintendent was Mr. J. A. Richardson, a fisheulturist formerly employed by the United States commission

at Baird, and by the California Fish Commission, as an assistant to Mr. J. G. Woodbury at the San Leandro Hatchery.

The work accomplished at the Shebley Hatchery was limited, owing to the small amount of money appropriated and the great cost of transporting the fry to the waters to be stocked. The commission had to pay expressage on all shipments of eggs and fry distributed. The principal work was the hatching of rainbow trout, the black-spotted trout of the Tahoe basin, and also a number of shipments of eastern brook trout and landlocked salmon. This hatchery was operated until 1888, when the board decided to establish larger hatcheries located near the egg-collecting stations, where an unlimited supply of water could be had. Accordingly, in 1888, after the distribution of fry was over for the season, the Shebley Hatchery was abandoned, and in the following spring the tools and apparatus that were the property of the state were shipped to the new hatchery on Lake Tahoe, at Tahoe City.

FRAZIER HATCHERY.

Frazier Hatchery was established in 1875 by I. C. Frazier, on Squaw Creek, Nevada County, under permit and authority granted by the State Fish and Game Commission. This hatchery was operated until 1880, when it was abandoned.

HURLEY HATCHERY.

The Hurley Hatchery was established in May, 1880, by John Hurley under permit from the Fish Commission. During that year there were hatched and distributed over 95,000 trout. Captain Todman, with the authority of the commission, leased the hatchery and hatched and released over 500,000 trout during the year 1887. The commission in 1888 took over the hatchery, and before the end of June had hatched and distributed over 600,000 trout.

HAT CREEK HATCHERY.

In 1885 the California Fish Commission decided to establish a hatchery for the propagation of salmon, as the federal government had not again resumed operations at Baird, on the McCloud River. After examining a number of sites, it was decided to establish a hatchery on Hat Creek, with the exception of Fall River the largest tributary of the Pit. Hat Creek is a large stream, carrying about 26,000 miner's inches of water, and is not subject to sudden floods. The commission had the plans of the hatchery made after the design of the old Baird Hatchery and let the work out by contract. The hatchery was a large building for those days; it was constructed of good material, was 100 feet long, 46 feet wide, and contained 64 hatching troughs when completed. It had a capacity of 90 troughs, but all were not put in, as the run of salmon did not justify the expense. There was a complete filtering plant and the hatchery was fully equipped to care for from 6,000,000 to 10,000,000 eggs. The year following its completion, Mr. J. V. Shebley took charge of the station. He began operations early in August, but although trapping and seining for the spawning salmon

FIG. 33. W. H. Shebley and H. E. Southern examining Klamath River trout on Cottonwood Creek, near Hornbrook, Siskiyou County, about 1904.

was continued until November, only 1,200,000 eggs were collected. The spawning beds that a few years before had been covered with thousands of spawning fish were now deserted. In 1887 W. H. Shebley was appointed superintendent of the Hat Creek station, to succeed J. V. Shebley, who resigned from the commission to engage in private business. The take of eggs the second year was less than that of the first. Every effort was made to procure sufficient eggs to justify the commission's operating the plant, but only 500,000 were taken.

In the spring of 1888 Superintendent W. H. Shebley recommended to the Board of Fish Commissioners and to Governor Waterman that the Hat Creek Hatchery be either abandoned or closed down for a number of years, and that a station be established lower down the river at a place where the salmon eggs could be collected and shipped to a hatchery along the line of the railroad. It was demonstrated beyond any doubt, during the two seasons that Hat Creek station was operated, that the spawning salmon did not reach Hat Creek, nor the Pit River near its confluence with Hat Creek, in numbers sufficient to justify the expense of operating the station any longer. In former years a large run of salmon ascended Pit River as far as the falls below the town of Fall River Mills, and also into Hat Creek; but owing to the diminishing number of salmon in the Sacramento River and its tributaries, the fish that ascended the river found ample spawning beds lower down, near the confluence of the Pit, the Sacramento and the McCloud rivers. The board, acting on this recommendation, ordered the hatchery closed and began looking for another site.

MOUNT SHASTA HATCHERY.

In August, 1888, Mr. J. G. Woodbury was appointed superintendent of hatcheries of the California Fish Commission. He immediately began to look for a suitable location for a large hatchery along the line of the railroad, at the headwaters of the Sacramento River. After making a thorough examination and a study of the conditions of the different streams, it was decided to locate the hatchery on Spring Creek, near the town of Sisson, on the property of Mr. J. H. Sisson. Spring Creek has its source in a large spring about a mile from the hatchery; the water is pure and cold and its temperature does not vary to great extremes. The good judgment shown by Mr. Woodbury and Dr. Stone in selecting this location has been proved by the successful work done at Sisson during the ensuing years.

The first hatchery on this site was built in the fall of 1888. It was a plain wooden structure 40 by 60 feet, containing 44 troughs, and was hurriedly constructed to accommodate the eggs that were being collected by the United States commission at Baird from the fall run of salmon in the McCloud River; for the federal commission had resumed operations on the McCloud River, after having closed the station for five years. An agreement had been entered into whereby the United States commission and the California commission were to divide the work of propagating salmon in California: the former was to collect and prepare the eggs for shipment, the latter to hatch and distribute them.

The Sisson Hatchery was completed and ready for operations in September, 1888. The floods did not interfere with the work, and Dr. Stone operated until late in November. Eight hundred thousand eggs were collected from the early fall run and 2,200,000 from the October and November, or late fall run. These eggs were hatched and the fry fed until they were large enough to care for themselves and then carefully distributed in the upper reaches of the Sacramento River and its tributaries.

The policy of feeding the fry was continued until 1895, when it was discontinued by the Board of Fish Commissioners as a matter of economy coupled with a wrong idea that had been advanced by those who were dictating the policy of the fishcultural operations in California

FIG. 34. The old Sisson Hatchery in 1894.

that the salmon fry were better off if distributed as soon as the umbilical sac was absorbed. The benefit of feeding the fry was plainly demonstrated by the great increase of the salmon in the Sacramento River in the years that followed the return of the output of fry from 1888 to 1896.

The fry at the Mount Shasta Hatchery are first held and fed in the troughs about two months before they are removed to the ponds. Then they are taken out in small lots and fed until all are accustomed to the new surroundings. The pondkeeper distributes the food slowly at the different feeding stations in the ponds, until he is satisfied that all the fry have received their share of food. By this method the fry all make the same development and growth, and there is no danger of developing a lot of precocious fry to exercise their cannibalistic instincts on the others.

In 1911 it was decided to again hold and feed the salmon fry until they were large enough to care for themselves when distributed, as well as to hold a large number of them in the ponds at the Mount Shasta

Fig. 33. Shasta Hatchery in 1916. On the grounds are five large hatchery buildings, several smaller hatching houses, and cottages for employees.

Hatchery until fall and then release them in the upper reaches of the Sacramento River during the early fall, before the winter floods. During the season of 1913 three quarters of a million salmon fry were held in the ponds at this hatchery and released during October. During the season of 1914, 21,000,000 salmon fry were held in the troughs, nurseries and ponds and fed until late in the spring. Of this number, 4,000,000 were placed in the large ponds at the Mount Shasta Hatchery in perfect condition, where they were fed daily and looked after by skilled fishculturists until the early fall, when they were released, so that their descent of the river might be less hazardous and a greater number might reach the ocean than is the case with the fry released in the spring or summer. This policy of holding and feeding all of the salmon fry before releasing them, and then only when the flood season is over in the spring, has unquestionably given good results. It is believed that it was the holding and feeding of the fry in the early history of the Mount Shasta Hatchery that increased the run of salmon in the Sacramento River, and that the present run is largely due to these efforts.

During the year 1913 three new ponds were constructed for the rearing of brood fish, making in all a total of fifty-one ponds and nurseries. With the increasing demand for fish to stock streams, it was found necessary to increase the pond system sufficiently to raise enough stock fish to supply the eggs.

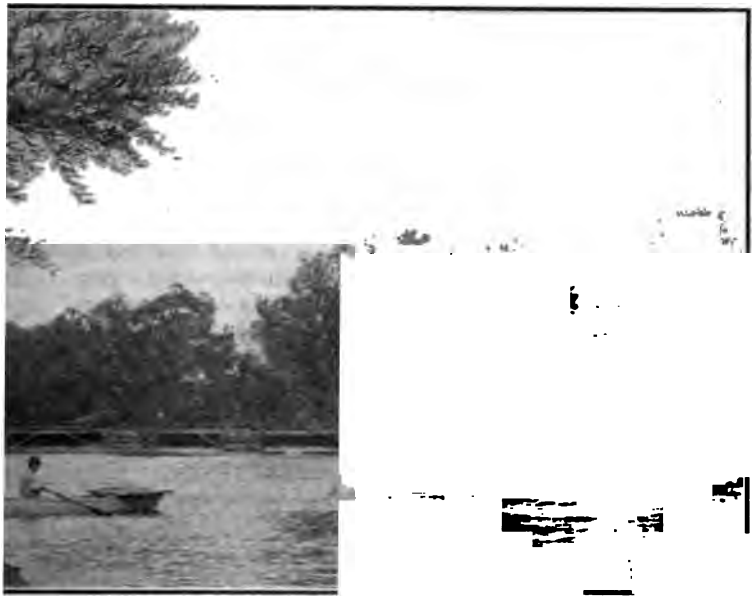
Located as it is at an altitude of 3500 feet above sea level, on the southern slope of Mount Shasta and in the heart of Strawberry Valley, with a wonderful supply of pure cold water, within a mile of the main line of the Southern Pacific Railroad and but a couple of hours by rail from the rainbow trout egg-collecting stations on the Klamath River, Mount Shasta Hatchery is ideally situated. It not only has a capacity for handling the bulk of trout fry, but is also capable of rearing a sufficient number of salmon fry to maintain the salmon run in the Sacramento River.

The development of this hatchery from a small salmon hatchery to its present size has been gradual. Each year permanent improvements have been made. From the first small permanent building, 40 by 60 feet, containing 44 troughs, erected in 1888, the plant has been enlarged until at the present time it includes seventeen acres of land owned by the state, with a water right of 700 miner's inches; fifty-one ponds and nurseries for the rearing of thousands of fish; five hatchery buildings containing 450 troughs; a superintendent's residence; three cottages for the foreman and assistants; a spawning house; a barn, sheds, garage and other buildings, and an electric lighting plant. The value of the lands and improvements, together with the apparatus and equipment necessary to maintain a station of this size, estimated at the cost of the purchase price and of construction, is $100,000. In addition to this equipment, the commission has leased outside the grounds but within a radius of a quarter of a mile of the plant, three large ponds which are used for rearing salmon fry. The capacity of these ponds is 3,000,000 fry. A one and a half-ton truck is used for hauling materials and supplies from the town of Sisson, which is one mile distant, and for hauling fish and eggs to and from the trains. As many as

fish are retained in the fifty rearing ponds as breeders. Ten million trout and salmon are hatched and reared at the station r.

MILL CREEK AND BATTLE CREEK HATCHERIES.

ork of collecting salmon eggs has been systematically carried .e joint operations of the federal and state commissions, with :t of increasing the number of salmon in the Sacramento River. :heries have been established for the work, one at Battle Creek, by the state commission; the other at Mill Creek, in 1902, by ral commission.



The first salmon-egg collecting station on Battle Creek in 1905. In the t year of operation the take amounted to ten million salmon eggs.

Battle Creek Hatchery has proved to be one of the greatest spawning stations in the world, as many as 60,000,000 eggs have been taken in one year. It was largely due to the efforts of Mr. Babcock that this fine station was located. He had taken a great interest in the propagation of salmon and recommended this site to the California Fish Commission. Battle Creek is one of the large tributaries of the upper Sacramento River; it rises in the watershed of Lassen and flows into the Sacramento River about twenty miles below Red Bluff. There is a lagoon two and a half miles long at its mouth in which the fall-run salmon gather in thousands. The California Fish Commission operated this station for two years, but owing to lack of funds, and desiring to see the station operated to its fullest capacity, a proposition was made by the state commission to Hon. J. J. Henshaw, then United States Commissioner of Fisheries, to purchase the station for a government station, the money thus obtained to be applied

to increasing the capacity of the Sisson Hatchery. Commissioner Brice accepted the proposition and laid the matter before Congress, and the necessary appropriation for purchasing the station was made. The eggs collected at this station, as well as at the other federal stations in the state, have been largely turned over to the California commission for hatching and distributing. During the two years that the Battle Creek station was operated by the California commission, Messrs. E. W. Hunt, superintendent of the Tahoe Hatchery, and W. H. Shebley, superintendent of the Sisson Hatchery, cooperated in the immediate supervision of the work.

The salmon have gradually increased as the result of artificial propagation and the protection of the spawning salmon on their way to the breeding grounds at the headwaters of the Sacramento River and its tributaries. As an illustration of the wonderful results obtained, the United States commission collected and shipped to Sisson from the summer run of 1888 but 800,000 eggs, and 2,000,000 from the late fall run. With this small beginning, the great work of restocking the Sacramento River gradually increased until, during the season of 1905–1906, the federal Bureau of Fisheries collected 100,000,000 salmon eggs at the three stations—Baird, Mill Creek and Battle Creek. During the season of 1903–1904, there were hatched at the Sisson Hatchery 58,000,000, and in the season 1905–1906, 96,000,000 salmon eggs. This great work was made possible by the construction of batteries of troughs outside of the buildings, in which to hatch the surplus eggs, the nurseries being used to rear the fry, as they could not be held in the troughs until large enough to be liberated.

MILL CREEK EGG-COLLECTING STATION.

This station is the property of the federal bureau, but was operated in 1912 by the California commission. Theretofore the salmon eggs had been hatched largely at Sisson, and as the prospects were unusually promising for the previous season it was feared the capacity of the Sisson Hatchery would be overtaxed. Accordingly, arrangements were made with the federal bureau whereby the state operated the Mill Creek station.

During the year 1902 a substation was established on Mill Creek, a stream which has its source in the foothills of the Sierra Nevada Mountains, in the northeastern part of Tehama County, and empties into the Sacramento River from the east about a mile above the town of Tehama. The eggs were retained here until eyed, and then were shipped to other hatcheries.

REDWOOD CREEK AND KORBEL HATCHERIES.

Continuing to increase their salmon operations, the United States Fish Commission in 1889 erected a salmon hatchery at Fort Gaston, in the Hoopa Indian Reservation in Humboldt County. An additional egg-collecting station was established on Redwood Creek in 1893, and the same year a new hatchery was built near Korbel, on Mad River, but on account of inaccessibility, all three stations were abandoned in 1

LAKE TAHOE HATCHERY.

In the spring of 1889 Superintendent Woodbury, acting under instructions from the Board of Fish Commissioners, decided to locate a permanent hatchery on Lake Tahoe. The state had been carrying on hatchery operations under the direction of Mr. I. C. Frazier, in a rented building that was not properly equipped to do good work. Each season a few hundred thousand eggs had been taken from the black-spotted trout of Lake Tahoe and shipped to the Shebley Hatchery in Nevada County, and when the fry were hatched they were shipped back to the Truckee and Tahoe region and distributed.

After a study of conditions the hatchery was located near Tahoe City, at the north end of the lake. The water supply was furnished from springs rising on the land used as a hatchery site. Thirteen acres were first rented, but later purchased so as to secure all the available water to be had near the site. At this hatchery millions of black-spotted trout were annually reared until 1916.

During the season 1891 the Tahoe Hatchery, as well as the other hatcheries, was not operated, owing to dissension among members of the board. Three private hatcheries, located at Del Monte, Glen Ellen and Alma, were supervised by the state for a few years, but the resulting hatch was negligible. In 1892 the Sisson Hatchery was reopened but the Tahoe Hatchery was not reopened until 1894, when Mr. E. W. Hunt was appointed superintendent. The work of propagating the black-spotted trout of Lake Tahoe was systematically taken up by Mr. Hunt, and the increased number of fish in the Tahoe region is evidence of his energetic and intelligent work. The increase of trout in Lake Tahoe, like the increase of salmon in the Sacramento River, is well demonstrated by the work of the egg-collecting stations. In 1890 the commission seined on all the available places in the lake where it was thought spawning fish could be taken, besides operating traps in three of the best creeks flowing into the lake, and only 873,000 eggs were procured. In 1910, 6,000,000 were taken at the Taylor Creek egg-collecting station alone.

THE NEW LAKE TAHOE HATCHERY.

By 1916 it had become more and more evident that the supply of water at the old site of the Tahoe Hatchery was entirely inadequate. Consequently, during the fall of 1917, a survey was made of all the available and suitable streams flowing into Lake Tahoe, and after a careful examination a site was selected at Walker Springs, one mile north of the present site, on the state highway. The Walker Springs run, during the minimum flow, 30 inches of water, and during the maximum flow a couple of hundred inches; and this during the season of greatest hatchery activity. Therefore the state secured a most desirable site to carry on hatchery work, and the only suitable water for hatchery purposes in the Tahoe Basin proper. The streams that have their sources in the mountain range surrounding Lake Tahoe carry too much detritus and are too roily during the time the snow is melting. After purchasing the property, plans were made by the state architect for a modern stone hatchery with four times the capacity of the old

FIG. 37. (Above) The old Tahoe Hatchery as it appeared in 1906. **(Below) The** new Tahoe Hatchery completed in August, 1920.

hatchery. The contract was given to Mr. Matt Green during the summer of 1919. Work was begun on the new hatchery that fall and was completed in the fall of 1920.

The new hatchery contains 64 troughs and has a capacity of about two and a half million trout. Provision has also been made for breeding ponds and nursery ponds and a superintendent's cottage. This new hatchery was made the more necessary because of the lack of water at the Tallac Hatchery during the past few years. The new Tahoe Hatchery is of sufficient size to handle practically all of the black-spotted trout operations.

At the request of Governor Stephens and the citizens of Placer County, the old hatchery grounds were converted into a public camping ground by an act of the legislature during 1918, and the management of this public park was placed with the Fish and Game Commission, which has improved and maintained it from the funds collected from hunting and angling licenses.

MOUNT TALLAC HATCHERY.

In 1895 Lawrence and Comstock erected a temporary hatchery near Tallac, about two miles from the mouth of Taylor Creek, and placed it under the control of the commission. The following year operations were moved to Tallac Creek. For a number of years a good proportion of the eggs taken in the vicinity were hatched at this station and distributed in the public waters of that region. However, owing to the distance from the spawning grounds and the small supply of water, it was decided in the fall of 1908 to abandon this hatchery and erect a substantial modern building on Taylor Creek near Tallac, where a large supply could be obtained and where the work of hauling the eggs to the hatchery in the early spring, when the country is covered deep with snow, would not be so difficult. After securing a lease for a term of years from Mrs. Anita M. Baldwin, the new building, 40 by 70 feet, was erected. It has a capacity of 3,000,000 eggs and is splendidly equipped. Since a dam was erected on the stream above the hatchery, however, water conditions have not been so good.

GLEN ALPINE HATCHERY.

Through the joint efforts of Mrs. George Pierce of Glen Alpine Springs, and Professor W. W. Price of Alta, a small hatchery was completed at Glen Alpine in 1905 and was operated as an auxiliary to the other two Tahoe stations until 1912. It was only a small building, the property of the Glen Alpine Hotel Company, having a capacity of 1,000,000 eggs, and was used by the commission to hatch out a few hundred thousand eggs to save the cost of transportation of the fry.

BEAR VALLEY HATCHERY.

To satisfy the feeling of necessity for a hatchery in the vicinity of San Francisco, and after careful examination of the waters of the neighboring counties, Bear Valley, in Marin County, was finally selected as the site for this hatchery, which was erected in the fall of 1891. It was operated as a trout station during the seasons of 1892 and 1893, but was closed for trout work in 1894. Owing to the limited supply of

water and the great distance from the railroad, it was considered neither economical nor expedient to operate this station longer. The efforts of the board were to concentrate the principal trout work at Sisson, aside from the work done at the Tahoe Hatchery for the propagation of the black-spotted trout of that region.

WAWONA HATCHERY.

In 1895, under the supervision of W. H. Shebley, a small hatchery was erected at Wawona, to provide fish for the lakes and streams in the Yosemite Park and adjacent country. The hatchery was erected and equipped by the Yosemite-Raymond Stage Line and turned over to the commission to be operated upon condition that an annual hatch of 500,000 trout eggs should be distributed in that vicinity. It was managed for a number of years by Mr. M. L. Cross, who was remarkably successful in the work, principally that of hatching rainbow trout eggs and eggs of the black-spotted trout of the Tahoe Basin. The eggs were shipped to this station, and the fry distributed throughout the lakes and streams of Yosemite National Park and the surrounding country. The German brown trout also has been distributed in a number of the lakes and streams, and has done remarkably well.

By 1916 the hatchery and equipment had become so old that operations were suspended. In 1918, however, a new hatchery was constructed on the old site and the old equipment temporarily installed. Later the newer equipment from the Yosemite experimental hatchery was substituted.

PRICE CREEK HATCHERY.

In its endeavor to increase the salmon supply in California the commission investigated conditions on Eel River, and in 1897 a hatchery was erected on Price Creek, one of the tributaries of Eel River, about twelve miles from its mouth.

The first eggs were shipped from Battle Creek to the new station in December of that year. This station proved to be a great success. Eel River, like the headwaters of the Sacramento, has no predatory fish except the trout to devour the salmon fry. The water of the river from the mouth of Price Creek to the ocean flows through deep pools, with very little current. The salmon fry find perfect conditions in this stretch of water, and enter the ocean with very little loss and in fine condition. This station has also been used for collecting and hatching steelhead eggs for distribution in the streams in Humboldt County. The increase of salmon in Eel River, following the establishment of this station, is another example of the benefit derived from artificial propagation. At the time the first salmon fry from the hatchery were liberated in Eel River during the spring of 1898, the average annual shipment of salmon from Eureka was about 500,000 pounds. After the establishment of the hatchery there was a steady increase, and in 1904 the shipment was over 1,500,000 pounds.

A most remarkable example of artificial propagation of salmon is shown at this important station. This hatchery, in Humboldt County, was established in 1897, at which time the average number of pounds

of salmon shipped from Eureka per year was less than 500,000. In 1899, 470,806 pounds were shipped from this territory. Five years later, 1904, the total number of pounds had increased to 1,877,000.

In 1902 this hatchery made the first plant in the state of steelhead trout fry. After the spring of 1906, when the restriction prohibiting netting became effective, there was a marked increase apparent. In operating one small trap on Price Creek (which was at different times flooded) the largest number of steelhead eggs ever taken in Humboldt County was secured. In 1916 the hatchery was moved to a point on Eel River near Fort Seward.

UKIAH HATCHERY.

During the season of 1897 Mr. A. W. Foster, president of the San Francisco and North Pacific Railroad Company, being desirous of adding to the attractions of the streams along the line of his road by thoroughly stocking them with fish, caused to be built at Ukiah a fish hatchery having a capacity of 2,000,000 eggs, and arranged with the commission to supply the hatchery with trout spawn, upon an agreement from him that the fish should be planted in public waters. Mr. Foster employed competent men to operate the hatchery, and in the spring of 1897, 700,000 trout eggs were forwarded to the Ukiah Hatchery. They were there successfully hatched and afterwards liberated in the public streams of Marin, Sonoma and Mendocino counties. In the spring of 1898 the commission forwarded to Ukiah 200,000 eggs. The number was reduced because the water supply of the section was affected by the dry season. The addition of this hatchery has been and will continue to be of great assistance in stocking the 1200 miles of trout water in these counties.

In 1911 the Fish and Game Commission took over complete control of the Ukiah Hatchery, since which date it has continued operations. Several years ago improvements were made at the station in order to permit the eyeing of all the steelhead trout eggs taken at the Snow Mountain station.

MEARS AND HAZEL CREEK STATIONS.

During the early part of 1898 the commission caused traps to be placed in Mears and Hazel creeks, tributaries of the Sacramento River, near Sims, hoping to increase the output of rainbow trout. Owing to the lack of rain these creeks did not rise and the usual run of spawn fish did not attempt to ascend them, and the project was a failure. The location, however, was considered good, and the effort was renewed the next year, but as the second attempt was also a failure it was considered wise to abandon the location and try a point on the Truckee.

The expense of the work at Sims was borne by the Southern Pacific Company.

VERDI EGG-COLLECTING STATION.

Following the failure of the attempt to take trout spawn from the Sacramento River, and still desiring to increase the output of rainbow trout fry, a point on the Truckee River known as the Essex dam, near

Verdi, Nevada, was selected, where in 1902 a cheap building was constructed and fitted up as a hatchery to hold the eggs until such time as they could be shipped to Sisson and Tahoe. The lease for the land used was donated to the board by Mrs. Margaret Foulkes of Verdi, Nevada.

The spawn fish were collected from the river by means of traps placed near the fishway on the dam, directly in front of the hatchery building.

The run of rainbow trout at this point was an agreeable surprise, and was made possible by the action of all the owners of dams in the river in Nevada in placing fish-ladders on the dams and by the efforts of the peace officers of Nevada, who enforced the closed season. The Truckee River rises in California, its head being in Lake Tahoe. It passes for many miles through the mountains of California and then runs into Nevada, emptying into Pyramid Lake, so that both Nevada and California are intimately concerned in any action that will lead to the betterment of the fishing interests of this river.

The authority for operations at this point was granted by the county commissioners of Washoe County, Nevada, who appreciated the fact that California and Nevada are jointly interested in improving the fishing conditions of the Truckee River. In addition to granting this authority, the commissioners exercised their power to have the laws enforced in Nevada. Between the last of February and the first of May 538,000 rainbow trout eggs were taken. In addition 500,000 black-spotted trout eggs were taken; for lack of hatching room, however, all but 218 black-spotted trout were liberated in the river above the traps. The total number of eggs collected at the station the first year was 1,038,000, part of which were shipped to the Sisson Hatchery and part to the Tahoe Hatchery, the balance being hatched and liberated in the Truckee River near Verdi, in Nevada.

So far as trout propagation is concerned, there is no stream so naturally prolific and so responsive to propagation and protection as this mountain stream. The take in the spring of 1904 was most discouraging, although the prospects were good. There were large numbers of good-sized fish to be seen, but the heavy and continuous storms kept the Truckee River at a flood stage for several months. The gates at the outlet of Lake Tahoe, which had been closed during the summer of 1903, had stored the water to a higher level than usual. This was quickly raised by the heavy rain and melting snow until it became necessary, in order to save the property around Lake Tahoe, to open the flood gates to their full extent. The continuous flow of such a large volume carried away dams and swept a great deal of heavy debris down the river, taking out racks and traps and making it impossible to replace them. The failure to make a good collection was due solely to the unusual conditions, the total take being about 75,000 eggs, 35,000 of which were eyed and sent to the United States Fisheries station at Leadville, Colorado. About 30,000 fry were hatched at Verdi and liberated in the waters of the State of Nevada.

In 1905 the station was discontinued, the Truckee River continuing at such a height that the capture of spawning fish was not feasible with the equipment at hand. The funds of the commission would not allow a permanent barrier or trap; at least, the number of eggs collected did not justify the expense at that time. The hatchery supplies were sent

to the stations on Lake Tahoe and at Sisson; the hatching troughs and other material too heavy to transport were donated to the State of Nevada, and have done some excellent service.

HORNBROOK EGG-COLLECTING STATION.

After a favorable report on the possibilities of taking rainbow trout spawn from Cottonwood Creek, Siskiyou County, had been made by W. H. Shebley, superintendent of Sisson Hatchery, in 1900, the board secured permission from Mr. David Horn, who owned the land on both sides of the creek, to trap the fish on his land and to make the necessary preparations to that end by constructing a temporary egg-collecting station. Accordingly, in January, 1901, operations were commenced by putting in a rack and large trap, also fitting up troughs in a tent for the purpose of eyeing the eggs before shipment to Sisson. It was found later, however, that the water supply taken from a spring, to be used for eyeing the eggs, was alkaline in character. Therefore operations for collecting eggs were carried on, and as fast as taken they were shipped direct to Sisson to be eyed and hatched. This proved to be both successful and economical, as the station required then only the services of one man to watch the traps, collect the spawn fish, and place them in a "live-box." Notwithstanding the fact that the trap was twice washed out by high water, 417,000 eggs were collected the first season. This was not considered a fair test of the capacity of the stream, as the storms were unusually severe and a warm rain on the deep snowfall caused freshets.

Operations were continued in the spring of 1902, and a new trap was put in in February, but the first run was lost because of floods which washed out the trap and allowed the fish to pass on up the stream. In spite of these drawbacks, 686,000 eggs were taken by the last of May. The cost of collecting the eggs being so slight, it was considered that the efforts and money had been well expended and that it would be advisable to continue to operate the station. The station was operated for several years by the California Fish and Game Commission and was then turned over to the United States Bureau of Fisheries, which continued operations until 1919, when the station was again returned to this department.

A careful investigation of Cottonwood Creek with reference to the collecting of rainbow trout eggs was made during the spring and early summer of 1919, with the result that a lease for a new site was obtained from Mr. Marshall Horn and a permanent system of racks was installed therein to trap the spawning trout as they ascend the stream. A new and larger holding-tank for the fish was also installed, and with the new equipment it was possible to obtain 1,600,000 trout eggs in the spring of 1920.

SALMON EGG-COLLECTING EXPERIMENTS ON EEL RIVER.

The commercial fishing at the mouth of the Eel River and the spearing of the breeding salmon on the riffles on the upper reaches of the river necessitated the propagation of salmon in larger numbers on Eel River. Experimental work was carried on at an experimental station on Bull Creek, one of the tributaries of the South Fork of the Eel

River, and also in the main river near the mouth. The results of these experiments of the last three years have not justified the expense of establishing a permanent egg-collecting station on the lower reaches of the river.

There are several conditions in that region that make it seem impracticable to establish an egg-collecting station there. The salmon, upon entering the mouth of the river, are compelled to remain in the large pond below Loleta until the river rises in the fall, as there is not enough water during the seasons of normal rainfall to allow the fish to pass over the wide, shallow riffles connecting the large pools from South Fork to the large pool at the mouth of the river.

As a rule the river rises to a considerable extent, but not before the majority of the salmon are caught by the commercial fishermen at the mouth of the river in the large pool. It has been suggested that eggs be collected from the fish in the large pool during the early fall before they ascend the river or are taken by the commercial fishermen, but we find that the fish do not ripen in numbers great enough to justify the expense of seining them up and separating the few ripe ones from those that are green or immature. Furthermore, there is no water near the mouth of the river suitable for hatchery purposes. If eggs could be taken in sufficient quantities to justify the expense of collecting them, they would have to be taken direct to Fort Seward Hatchery on the railroad, some sixty miles up the river. The eggs collected would, in all probability, be in such small lots that it would not pay to keep the necessary help and equipment.

Any attempt to place racks across the main Eel River or the South Fork, anywhere near its mouth, is almost impossible, as the loose nature of the formation is not solid enough to hold the racks and, even if this were overcome, the tremendous amount of water that comes down Eel River during flood periods, carrying logs and debris of all kinds, would make it impossible to retain any kind of a rack in the river. Furthermore, if a rack could be built that would stand the flood water of the river when the salmon were running, the number of fish that would be entering the river would be all fresh run from the ocean and would have to be held too long in order to allow them to mature.

An egg-collecting station on Eel River or its tributaries must be situated far up the stream, away from the tremendous floods and the floatage matter in the river, and must be in the upper reaches near the spawning grounds, where the fish have spent the necessary time in fresh water for the breeders to mature.

It takes less fry to stock Eel River and maintain the run of salmon than any other river on the coast, as there are few natural enemies of the young of the salmon to be found in the river. There are no predatory fishes, no diverting canals to carry off the water where fry are lost, or overflow basins, and very few water snakes or other natural enemies. If only a few million eggs can be collected and the resulting fry planted each season, the run of salmon in Eel River can be easily maintained provided the fishing at the mouth of the river is regulated as well as the ocean fishing, where large numbers of salmon are taken each season.

EEL RIVER EGG-COLLECTING STATION.

Extensive egg-collecting equipment was installed during the fall of 1921 on the South Fork of Eel River, near Branscomb. Racks, traps, holding pens and cabins for the assistants have been put in on the South Fork of Eel River. Racks and traps have also been placed in Charlie Creek, and on Kinney Creek an eyeing station has been put in and racks, traps, pens, etc., installed. The station has been equipped for extensive operations, and it is the intention to collect the eggs of the steelhead trout as well as those of the salmon.

BROOKDALE HATCHERY.

In 1905 Mr. F. A. Shebley located a hatchery at Brookdale for the county of Santa Cruz, on a tributary of the San Lorenzo River, twelve miles from the city of Santa Cruz. It has proved to be one of the best steelhead hatcheries on the coast, and the increased number of steelhead trout in the streams of Santa Cruz County is sufficient evidence of the success of this station. An auxiliary of the Brookdale Hatchery was established on Scott Creek, and it has been jointly operated by the California Fish Commission and Santa Cruz County. The fry hatched from the eggs collected at this station are distributed in the waters of Santa Cruz, San Mateo, Santa Clara and Monterey counties, and some of the eggs are shipped to Sisson and Eel River hatcheries for distribution in other localities. Beginning with July 1, 1912, both Brookdale Hatchery and Scott Creek spawning station have been operated exclusively by the state and a general distribution made of the product.

EDGEWOOD EGG-COLLECTING STATION.

After the abandonment of the station at Verdi, the commission still considered it wise to establish a station on some stream where a supply of rainbow eggs could be collected at small cost. Superintendent W. H. Shebley of Sisson was sent to examine the different streams in Siskiyou County for that purpose. He selected a point on the Shasta River near Edgewood, Siskiyou County. The cost of operating was light and, besides, the eggs could be transported direct from the spawning station to the Sisson Hatchery, avoiding the expense of a double crew of men.

The station was operated for the first time in 1906, but owing to unusual freshets which swept over the racks, most of the spawning fish were able to pass them, so that only about 50,000 eggs were taken. This, however, was considered sufficient to demonstrate the value of the station. An agreement was entered into with the Federal Bureau of Fisheries, which desired to establish a rainbow egg-collecting station, whereby the federal bureau was to bear part of the expense of operation of the station and was to receive in exchange the privilege of eyeing their eggs in the Sisson Hatchery. This arrangement was considered mutually beneficial to both commissions, and it tended to insure a continuance of the harmonious relations that existed between the two.

THE SACRAMENTO EXPERIMENTAL STATION.

During the fall of 1911 the commission decided to carry on a series of experiments to determine whether the eggs of the quinnat salmon could be successfully hatched and the fry reared near the city of Sacra-

mento. It was thought that if water could be found in which the eggs could be hatched without causing injury to the eggs and embryos, a greater percentage of the fry would safely reach the ocean than would be the case if they were all liberated in the upper reaches of the river near the natural spawning grounds. It was maintained that under the old system of liberating the fry as soon as they were able to swim, a great many of them were devoured by predatory fishes, and others were carried into the overflow basins during years of flood.

Accordingly the station at Sacramento was established. Mr. F. A. Shebley conducted the work in addition to his duties as superintendent of the Brookdale Hatchery. The experiments as carried on at Sacramento were of vital importance to the salmon industry. After experimenting with the water from a number of wells, a flow of water was found on the Sherburn tract that appeared to be pure enough for salmon propagation. The fish hatched at this station were all released in the Sacramento River. Of these, 50,000 were marked in order to determine by careful observation whether a greater percentage return as mature salmon than those that were released on the upper reaches of the Sacramento River.

Nearly all of the fry that were liberated in the Sacramento River were floated in a screen cage by boat into the middle of the stream and there released. Mr. N. B. Scofield, however, took 500 in a floating box down the river, where they were held and fed for several weeks in brackish and salt water. They were not affected by the sudden change from the fresh to brackish and then to the saline waters of the straits near the outlet of the bay.

In the course of the experiments and in the search for suitable water for hatching purposes, two wells were bored and the water from other wells was also analyzed and experimented with. The batteries or series of troughs used in these experiments were set up in the open air near the wells, and the pumping plants were installed temporarily. The best results were obtained from the well on the Sherburn tract. Here a battery of 40 troughs was set up on the levee, and the pumping plant installed in a small building of corrugated iron. These experiments were continued until the season of 1912–1913, but with no favorable results. The water did not have the life-sustaining qualities of mountain stream water, although a well arranged system of aeration was used, and the conclusion was reached that the well water all through the valley contains too much mineral to hatch salmon eggs without destroying or injuring them so badly that they will not thrive if they should hatch out. The undertaking was accordingly abandoned in 1913, the station was closed and the troughs and other apparatus were shipped to the Sisson Hatchery.

BEAR LAKE HATCHERY.

With the aid of the San Bernardino Trout Association, San Bernardino County in 1914 built a trout hatchery with a capacity of 1,000,000 fish. The hatchery was located on the south side of Bea It w built under the supervision of Mr. E. W. Hunt, superi Tahoe Hatchery. The expense of the hatchery was bers of the county association, and no money was s

county. The board of county supervisors had charge of the distribution of the fish hatched and were able to see to it that the local streams were well stocked with the output.

The object of this hatchery was to propagate rainbow trout from the fish in Bear Valley Lake. Bear Valley Lake (locally known as Big Bear Lake) is a body of water seven miles long and one and a half miles wide at its widest part. It is an artificial storage lake lying in the heart of the San Bernardino Mountains, about thirty miles from San Bernardino, at an elevation of about 7000 feet. This lake was stocked previously with rainbow fry from the state hatcheries, and these fish thrived remarkably. The association did not make a success of the hatchery and turned it over to the Fish and Game Commission.

In 1919 the necessity of increasing the capacity of the Bear Lake hatchery at Green Spot Springs became apparent, the old buildings that had been erected by the Southern California Trout Association being found inadequate. After procuring a permit from the forest service for a site adjacent to the site leased from San Bernardino County, a new hatchery with modern troughs was erected and fully equipped for the hatching and rearing of trout fry. The site at Green Spot Springs is about twelve miles from the egg-collecting station at North Creek. This is the only water available for hatchery purposes near Bear Lake. All the creeks dry up as the summer advances, except some small springs used for domestic purposes.

The Green Spot Springs rise near the foot of Sugar Loaf Mountain and flow through a shallow ravine toward Baldwin Lake. The water is used by the Shay Brothers on their stock ranch, after it leaves the hatchery. There is approximately 20 inches of water in the spring. It is cool and free from any organic substances, and is excellent hatchery water.

During the summer and fall of 1919, general improvements at North Creek Egg-collecting Station were made, and a new hatchery at Green Spot Springs with a capacity of 1,500,000 fry was erected. The work was begun early in September, but owing to delays in getting materials was not finished until late in November. At the hatchery at North Creek Egg-collecting Station, a portion of the eggs are hatched each season and the fry held until they are swimming well; then they are distributed in the most favorable places in Bear Lake, where there is an abundance of natural food. The fry can not be held in North Creek station later than the middle of July, as the water in North Creek fails by that time. The remainder of the fry reared for Bear Lake are held in the hatchery at Green Spot Springs until later in the season, when they are distributed in the lake in the shallows and other favorable spots.

During 1919 plans were made to build suitable quarters for the help at North Creek Egg-collecting Station, a cabin and a new trap on Metcalf Creek, and a cabin and a trap on Grout Creek. A new trap was built in North Creek, and the egg-collecting station and hatchery were repaired and improved.

The principal streams entering Bear Lake—North Creek, Metcalf Creek, Butler Creek and Grout Creek—were filled with sand from the high-water mark on the lake shore to the water's edge, averaging in

length from one-fourth to one-half mile. The creeks are all short, but carry a large amount of granitic sand caused by the disintegrated granite formation through which these streams flow. These creeks had been filling up for several years, until in the spring of 1919 it was almost impossible for the breeding trout to enter them, as the water was spread over such a wide area of sand deposits that the fish could not find water of sufficient depth for them to swim in. In order to open these channels so that the fish could enter the streams and reach the traps, teams and scrapers were hired and the channels excavated through the sand deposits so that the water would have sufficient depth at the mouth of the creeks. The spawning area above the traps is so small that it does not justify allowing any of the fish to spawn naturally. The streams nearly all dry up before the eggs are hatched, even if they are allowed to ascend the streams and deposit their eggs. The majority of the eggs deposited by the breeders below the traps do not hatch, as they are covered over with the sand that packs so tight over the eggs that they are smothered. Consequently the stock of fish in Bear Lake must be kept up by artificial propagation almost entirely.

Years ago, when the lake was first stocked, the sand deposits were not so great, as the flood waters scoured the streams out each season; but during the last five or six years the sand has accumulated to such an extent that the creeks must be kept open by removing the sand every two or three years so that the fish can reach the traps.

Bear Lake has an abundance of natural feed for the trout. Besides the minnows there are a great many varieties of aquatic insects that abound in the lake in great numbers. During the last three seasons of drought these insects have increased, so that it is safe to say that there is not another body of water of equal size anywhere that has the same amount of natural food for trout.

SNOW MOUNTAIN EGG-COLLECTING STATION.

The Snow Mountain Egg-collecting Station was established in 1907. Early in the season of 1915 the commission secured a lease on the Cape Horn dam from the Snow Mountain Water and Power Company for one year, with the option of an additional five years. This lease gave the commission the use of the grounds and buildings, as well as the privilege of constructing tanks, traps, etc., on the land described in the Snow Mountain Egg-collecting Station lease. The dam that makes it possible to collect the fish is located on the south fork of Eel River, about twenty-five miles from Ukiah, Mendocino County. All the steelhead trout that ascend this branch of Eel River are easily trapped in the fishway over the dam. A small battery of hatching troughs was installed and holding pens for the spawning fish were provided. As the fish ascend the fish ladder they are automatically trapped and swim directly into the holding pens, from which they can not escape. It is a very cleverly arranged scheme, and in addition to being a saving by eliminating a great deal of work, lessens the loss of fish from handling. Snow Mountain station is one of the best steelhead egg-collecting stations on the coast.

FORT SEWARD HATCHERY.

Owing to the undesirable location of the Price Creek Hatchery, it was decided to remove it to a more favorable site. Price Creek Hatchery was located on Price Creek, one-half mile from its junction with Eel River. The creek has its source in the hills near the mouth of Eel River. The country through which it flows is a loose, friable and disorganized formation that is constantly sliding and washing away. During the winter months the creek was so full of sediment that it was only with the greatest skill and care that fish could be reared at all. In the spring the water dried up rapidly and became very warm, so that it was impossible to hold the fry later than June. The commission decided, therefore, to remove the hatchery to a more favorable location. The Department of Fisheulture was instructed to select a suitable site and to move the station. After a careful survey of the streams on the line of the Northwestern Pacific Railroad, Fort Seward Creek was selected, a cold, clear stream, flowing into Eel River and about four and one-half miles above old Fort Seward, Humboldt County. The commission purchased forty acres of land near the mouth of the creek and selected a site for the hatchery about one-quarter of a mile from the Northwestern Pacific Railroad.

Early in 1916 the work of moving the building and equipment to the new site on Fort Seward Creek was begun, being completed and ready for the spring hatch of eggs. A cottage for the superintendent and a cabin for the men were erected and finished in a rough way until more comfortable quarters could be arranged.

The hatchery building is situated near the creek in a narrow canyon and the superintendent's dwelling on an eminence overlooking the hatchery. As funds were limited at the time the hatchery was established, only a poorly constructed cabin could be built for the help besides the cottage for the superintendent. During the fall of 1919, two four-room cottages, of plain interior finish and shingled outside, were built, so that men with families could be employed.

The water in Fort Seward Creek is the only water suitable for hatchery purposes on the line of the Northwestern Pacific Railroad. There are several streams between South Fork station and Fortuna, but they all have their sources in the same sedimentary formation as Price Creek, where it was necessary to abandon the hatchery owing to the great amount of sediment carried in the water during the winter and spring, when the rainy season was at its height.

The fry produced at this hatchery are the best reared in any of the hatcheries located in the coast counties.

YUBA CITY SHAD HATCHERY.

Early in the season of 1916 the question of propagating shad was taken up by the Department of Fisheulture. The heavy fishing for shad in the bays and in the Sacramento and San Joaquin rivers in previous years had caused noticeable falling off in the numbers of these fish, and to keep the supply up it was deemed necessary to resort to artificial propagation.

About the same time, a request was received from the Massachusetts and Connecticut fish and game commissions requesting the California

commission to collect shad eggs from California waters and ship them to their hatcheries, as they were desirous of restocking the depleted waters of the Eastern states with shad. Shad were introduced into California from New England states by the California Fish Commission in 1871. They increased rapidly until a few years ago, and the Sacramento and San Joaquin rivers were fairly alive with them in the spring and summer, when the run of shad was at its height.

The excessive fishing and pollution of the Eastern rivers has caused the shad to become very scarce, and it was the desire of the Massachusetts and Connecticut commissions to restock their waters. It was decided to collect the shad eggs for the two commissions, as it was considered an opportune time to carry on experiments to locate the spawning places of shad, as well as to make experiments to determine whether shad culture could be carried on successfully in California and to determine whether the process of fertilizing the eggs and propagating the fry could be improved upon.

Consequently the commission decided to operate a shad hatchery on a small scale during 1916, to carry out the experiments and to gather data in preparation for more extensive operations the following season. When operations were begun, in May, it was thought that all the eggs necessary for the shipments East, as well as for our experiments, could be collected by the latter part of May or early in June, but the season proved to be unfavorable and the work dragged along into July without sufficient eggs being obtained at one time to make a shipment East.

Fishing began on June 3 at Yuba City. The run was poor all through the season in the upper reaches of the rivers; nowhere near its size in former years. The light run of shad in the upper river was due to the very cold spring, cold water, and later to the high, roily water caused by the melting snow in the higher altitudes. During the season 1,421,000 shad eggs were collected and 872,000 fry hatched and successfully released in the Feather River. This work was under the immediate supervision of Superintendent G. H. Lambson of the Mount Shasta Hatchery.

BURNEY CREEK EGG-COLLECTING STATION.

In the spring of 1915 a lease was secured on a piece of land at the mouth of Burney Creek, a tributary of Pit River, Shasta County, for the purpose of collecting rainbow trout eggs. A rack was placed across the stream and the necessary live cars and pens were made to hold the fish that were expected to enter the creek. A tent and a few troughs under it with hatching equipment was set up and operations were begun. It was originally planned to eye the eggs and hatch them in the old Hat Creek Hatchery, seven miles from Burney Creek, if a sufficient number were taken; but early in May an eruption of Mount Lassen sent a tremendous flood of mud, water and sand down the Hat Creek Valley, destroying all the fish in the stream from its source to its confluence with the Pit River. This was one of the most serious destructions of fish life in recent years in California. Hat Creek rises in the southeastern part of Shasta County, in a lake at the foot of Mount Lassen, at an altitude of 7300 feet above sea level. It flows northerly into the Pit River, two miles northwest of Carbon, where

the old Hat Creek Hatchery was located. It is thirty-eight miles in length. Its principal tributaries are Rising River, a short stream arising from large springs in the lava, and Lost Creek. Rising River is only two miles in length, but has an average flow of 380 second-feet of water. Hat Creek, before its confluence with Rising River at the town of Cassell, has an average flow of about 100 second-feet during the summer months. Hat Creek and its tributary, Rising River, were noted for the excellence of their rainbow trout. After the flood of mud and Sand from Mount Lassen, the only survivors in the valley were those that were in Rising River. The water was muddy all during the season of 1915, and during the following years continued so muddy that it was not considered practical to restock the stream. It will probably be several years before fish will again thrive in Hat Creek, as the shifting sand deposited by the volcano destroys all the insect life in the stream, as well as making it uninhabitable for trout.

The fish enter Burney Creek late in the summer, but the run is a protracted one, lasting from April to August. The fish are late in developing, and if the fry were reared in a higher altitude and the progeny spawned later each season, a fall-spawning rainbow trout could probably be developed. This might have some advantages over a spring-spawning fish, as such trout would be in fine condition for the anglers when the fishing season opens in the spring.

MARLETT-CARSON HATCHERY.

The supply of eastern brook trout fry was increased considerably in 1916 and 1917. The Nevada State Fish Commisison did not operate its hatcheries, and the California commission was able to secure the privilege of collecting eggs from Marlett Lake, Nevada. The Carson City Hatchery was taken over by the commission, and the eastern brook trout eggs collected from Marlett Lake were shipped to this hatchery, where they were eyed and prepared for shipment. At this station 690,000 eggs were collected. The second year but half the eggs taken were to go to California under the agreement entered into. The share shipped to the Mount Shasta Hatchery amounted to 200,000 eggs.

DOMINGO SPRINGS HATCHERY.

An experimental hatchery was established at Domingo Springs in 1916. Improvements were made during 1917, when the temporary plant was moved to Rice Creek, one of the main branches of the North Fork of the Feather River above Lake Almanor. A thorough test of the water and an investigation of the run of fish resulted in the establishment of a permanent egg-collecting station and hatchery at this place. Accordingly, during the summer and fall of 1919, a permanent building was erected and a substantial trap constructed, one-quarter of a mile below the falls, in Rice Creek. The site was procured from the United States Forest Service. This desirable station will furnish fry for the entire region surrounding the west side of Lake Almanor, as well as the lakes and streams in the Mount Lassen National Park and surrounding country.

ALMANOR HATCHERY.

Almanor Hatchery was established in 1916 at the Big Meadows dam of the Great Western Power Company on Lake Almanor. It produced 261,000 rainbow eggs in 1918 and 282,000 in 1919. The water supply fails too early in the summer to permit the hatching and rearing of fry at the station, and accordingly the eggs were transferred to Clear Creek or Domingo Springs hatcheries as soon as they were "eyed."

YOSEMITE EXPERIMENTAL STATION.

With the intention of keeping the streams of the Yosemite Valley adequately stocked with trout fry, the commission during the fall of 1917 made a survey of conditions obtaining in the valley with reference to the establishment of a hatchery. A suitable site was obtained for a fine hatchery near Happy Isles, and application was made to the Department of the Interior for a lease to the property required for operations. Every assurance was given by the Yosemite Park officials that the department would grant a suitable lease, and pending the outcome of negotiations for the same the commission took advantage of a temporary permit granted it to establish an experimental hatchery on the site, in order that it might be definitely determined as to the practicability of the location for the propagation of trout. Arrangements were made with the State Department of Engineering for the preparation of suitable plans for the permanent hatchery.

The experimental station was established during the fall and winter of 1918 and was opened up for operations in the spring of 1919. Four hundred thousand rainbow, black-spotted and steelhead trout eggs were shipped to the station, and the resulting fry were reared and planted in the streams and lakes of the Yosemite Valley with the cooperation of park officials. The fry produced were vigorous and healthy and attained an unusual size in the few months that they were reared in the hatchery.

The site was demonstrated as being satisfactory for hatchery purposes, but as it is against the policy of the state to erect permanent buildings on leased land it was decided at a meeting of the Board of Fish and Game Commissioners, held during the latter part of October, 1920, to abandon the project. All equipment was therefore removed from the site and transported by auto trucks to the Wawona Hatchery, where it has been used to equip that station for more extensive operations.

MOUNT WHITNEY HATCHERY.

On February 2, 1917, the Mount Whitney Hatchery, located on a forty-acre tract on Oak Creek near the town of Independence, Inyo County, was turned over to the Fish and Game Commission by the Department of Engineering, under whose supervision the hatchery was constructed. The building is a beautiful structure of granite and gabro, and the coloring of the rubble walls blends harmoniously into the background of giant peaks that form the west wall of the valley. The building contains offices, storerooms and a laboratory on the lower floor and living quarters for the help in the upper story of the structure. It is equipped with up-to-date plumbing. All the troughs have

a separate water supply. The aerating system is on the latest and most modern lines. The waste pipes, catch basins and drains are all of concrete. As a matter of necessity the first season's output was comparatively small, but the 1,285,000 fish distributed in the waters of southern California, the lower San Joaquin Valley, Inyo and Mono counties, were an exceptionally fine lot of fish. The ample supply of pure water in Oak Creek, that gushes from the granite rocks of the basal slopes of the Whitney Range, has proved to be excellent for the propagation of trout. The fry advance very rapidly and are strong

FIG. 38. Picturesquely situated at the eastern base of the Sierra in Inyo County, the Mount Whitney Hatchery is the best constructed and best equipped hatchery in the state.

and vigorous. The distribution of the fish has been very satisfactory in every particular.

The grounds around the hatchery have been ornamented and improved. A large pond has been constructed, in which there are a number of adult trout of different species. Surrounding the pond are extensive lawns and beautiful flower gardens, roadways, paths, etc. While it is true that the station is located at a considerable distance from some of the southern California and San Joaquin Valley sections, which receive their supply of trout therefrom, the transportation facilities are very good, the trains being run on schedules which permit of the fish being delivered to the applicants within a very short time after leaving the hatchery. Consequently the fry are in the very best possible condition when planted in the streams. While it may appear, to one not familiar with the existing conditions, that the distribution of the fish from Mount Whitney Hatchery is more expensive than from

other stations on account of the high rate of fares from Mojave to Owenyo, the very reverse is true, for the trips of the distribution car are all comparatively short ones, enabling distribution work to be completed within a short time, which materially lessens the cost of distribution. But the most important feature of this hatchery is the excellence of the fry produced. They are truly wonderful fish, and the advantage to the southern waters resulting from the planting of such fry is inestimable.

The most interesting work undertaken at this station, from a fishcultural standpoint, has been the propagation of golden trout obtained from the Cottonwood Lakes station. The propagation of this species is very difficult, owing to the weakness of the embryos. The embryos hatched seem to lack vitality, and it is only by exercising the greatest care and patience in handling the eggs during incubation and in caring for the embryos, that the fry survive at all. However, golden trout are being successfully reared, and some very excellent results are expected from the stocking of the streams and lakes of the southern high Sierra, in which section conditions are propitious for the successful development of this species.

A supply of rainbow trout eggs is procured from the Rae Lakes, a system of lakes lying in the heart of the Sierra at an elevation of 10,500 feet above sea level.

RAE LAKES EGG-COLLECTING STATION.

The Rae Lakes Egg-collecting Station was established during the late spring of 1917 to furnish rainbow eggs for the Mount Whitney Hatchery. At the site of operations the altitude is 10,500 feet above sea level, located on a beautiful chain of lakes set in the heart of the high southern Sierra in Fresno County. The lakes are well stocked with rainbow trout. To reach the station in time to trap the fish as they enter the streams to spawn is extremely difficult. The trip into the lakes must be made via Oak Creek Pass, at an elevation of over 11,000 feet. There are few trails and the trip must be made through the blind mountain passes, over great depths of snow. Severe snow storms in this section, even in June, when the fish are spawning, are frequent. Even when the days are clear and warm the nights are freezing cold, and the journey through the passes is at best a difficult one, taxing the strength and resourcefulness of the hardiest mountaineers. Owing to the difficulties attending the opening up and operation of this station, and to the fact that sufficient skilled help to operate all the state hatcheries to capacity could not be obtained, this station was not utilized during 1918 and 1919. It was again operated in 1920 and 1921.

COTTONWOOD LAKES EGG-COLLECTING STATION.

During the summer of 1917, preliminary surveys were made of the Cottonwood Lakes country, Inyo County, to ascertain whether it would be feasible to undertake the propagation of golden trout.

The Cottonwood Lakes are situated in a rugged, almost inaccessible section of Inyo County near the Tulare County line, at the head of Cottonwood Creek. The lakes were stocked in the early seventies with golden trout from Mulkey Creek, a tributary of south fork of Kern River, and are now teeming with this most beautiful and gamey fish.

It was found that a number of creeks flowing into the lakes furnish excellent spawning grounds, and on what appeared to be the most favorable locations it was decided to put in racks and trap the fish as they ascended the streams to spawn. All arrangements were made to be on the ground at the proper time. All of the lumber, tools, tents, camp equipment and supplies had to be transported by pack train overland from Lone Pine. However, this was all successfully accomplished, and the men reached the site of the station in ample time to catch the first of the fish ascending the streams to spawn. Five hundred thousand eggs were taken and were successfully transported by pack animals from the spawning station to Mount Whitney Hatchery. The resulting fry were distributed in waters of that section.

The remoteness of the site of operations from railroads, highways or, indeed, any human habitations, the high altitude and prevalence of snow storms, make the trip into this remote section at this season of the year actually dangerous at times. Nevertheless the work has been continued, and crews have gone into the "lakes" each season and successfully accomplished their mission. The results obtained have justified all the hard work and expense. Although several efforts have been made in past years to collect the eggs of the golden trout, the attempt during 1918 was the first successful one. The success of the operations has been due to the skill and resourcefulness of Mr. George McCloud, who was in personal charge of the golden trout egg-collecting operations at Cottonwood Lakes and of Mount Whitney Hatchery, at which station the eggs were hatched and the fry reared. The golden trout are very difficult to rear, but the results obtained in this delicate work have exceeded expectations. The station was again operated in 1919 and 1920, but due to adverse weather conditions was not opened in 1921.

FEATHER RIVER EXPERIMENTAL HATCHERY.

During the spring of 1918, following out the plan of increasing the number of small hatcheries throughout the state, an experimental station was established in Plumas County, on the line of the Western Pacific Railway on a site on Grey Eagle Creek, about a mile from the town of Blairsden. Steelhead eggs were shipped to the station from Snow Mountain station, black-spotted eggs from Tallac Hatchery, and rainbow eggs from Domingo Springs station, the plan being to thoroughly try out this site in order that a permanent hatchery might be erected thereon should the water prove to be satisfactory for hatchery purposes. From this hatchery all of the trout fry for Plumas, Lassen and Modoc counties, along the line of the Western Pacific and the Nevada, California and Oregon railways could be hatched and distributed. With the inland territory in the Westwood, Lake Almanor and Juniper Lake districts covered by the Clear Creek and Domingo Springs hatcheries, and all railroad deliveries for the three counties above mentioned taken care of by the Feather River Hatchery (as the plant near Blairsden was to be named), all long hauls to this section from the Mount Shasta Hatchery could be eliminated. Unfortunately the water of Grey Eagle Creek did not prove satisfactory for hatchery purposes, and it became necessary to locate the hatchery in this section on some other creek. In 1921 the hatchery was moved to a site on Jamison

Creek, a tributary of Feather River. The station is located near Johnsville, in Plumas County. The operations last season were successful, and accordingly plans were made for the establishment of a permanent hatchery at this site.

CLEAR CREEK HATCHERY.

The Clear Creek Hatchery and Egg-collecting Station was established in the fall of 1918, on the creek that bears its name, one and one-half miles from the town of Westwood, Lassen County. Clear Creek is a tributary of the Hamilton branch of the Feather River, and a large portion of the spawning rainbow trout that ascend the Hamilton Branch of the Feather River enter this stream. As the source of Clear Creek is in a large spring, the water is pure and cold. The Red River Lumber Company furnished the site and material for the Clear Creek Hatchery, and the Fish and Game Commission furnished the labor for construction. Operations at this hatchery have been very satisfactory.

FALL CREEK HATCHERY.

In January, 1913, the California-Oregon Power Company began the construction of a concrete dam in the Klamath River two and a half miles above the mouth of Fall Creek in Siskiyou County. This dam, 110 feet high, has required a great deal of study on the part of the fishcultural department. The great problem involved was whether an efficient fishway could be constructed on such a dam, and if such a fishway were constructed, what would be the benefit derived from such an undertaking. The principal run of fish on the Klamath River in the region of the Copco dam is trout and salmon. The Federal Bureau of Fisheries has operated a salmon egg-collecting station on the river below the dam and have for the last eight years prevented the salmon from ascending the river above the racks at Hornbrook. This is necessary in order that the supply of salmon may be maintained in the Klamath River. If the racks were removed and the salmon allowed to ascend the river, and a fishway constructed that would allow the passage of the breeding salmon above the dam, the resulting fry would have to return to the ocean and on their downward journey would be destroyed by the power wheels of the hydroelectric plant that takes the water from the dam. Therefore the construction of a fishway for the passage of salmon above the Copco dam was not feasible. Accordingly, in compliance with the law, the Fall Creek Hatchery was constructed and paid for by the California-Oregon Power Company in lieu of constructing a fish ladder over the Copco dam in the Klamath River.

Under the provisions of the law passed by the legislature, whenever a dam or other obstruction is placed in a river or stream that, in the judgment of the Fish and Game Commission, is too high for the successful operation of a fishway, or for other reasons it is deemed best to establish a hatchery below the dam for the propagation of any species of fish that may be interfered with by the construction of the dam, the owners of the dam must construct and equip a hatchery for the purpose of propagating fish for the river and turn the hatchery over to the state for operation.

A site was selected on Fall Creek, a tributary of the Klamath River, at a distance of fourteen miles from the town of Hornbrook and along the line of the old Klamath River Railroad. A substantially constructed hatchery building, with a capacity of 100 hatching troughs, a cottage for the foreman and living quarters for assistants, comprise the equipment. The hatchery, completely equipped for fishcultural operations and with a capacity sufficient to adequately take care of requirements in that section, was completed and ready for operation in the spring of 1919. The Chinook salmon eggs, taken at the Klamathon Hatchery during the previous fall, were hatched here and the fry reared for distribution in the Klamath River and tributaries during the spring and summer of 1919.

A large portion of the rainbow trout eggs taken at the Bogus Creek station are immediately transferred to the Fall Creek Hatchery, where they are "eyed," and later all surplus eggs over and above the amount required for stocking the Klamath River are shipped to other stations to be hatched and reared for general distribution. The racks and traps are located at Klamathon, where successful egg-collecting operations have been carried on by the California Fish and Game Commission and the United States Bureau of Fisheries for several years. The hatchery on Fall Creek is but twelve miles from the racks at Klamathon.

BOGUS AND CAMP CREEK EGG-COLLECTING STATIONS.

Since 1910, rainbow trout egg-collecting operations have been carried on in the Klamath River section by trapping the spawning fish as they ascend Bogus Creek and Camp Creek. The racks, traps and holding tanks in both of these creeks were in a very poor state of repair by 1919, and accordingly, in the fall of that year, the old egg-collecting plant was removed and new equipment installed. The success of operations after the new equipment was installed was very marked.

The spawning operations at these two creeks are carried on by the same crew, as they are but a short distance apart, Bogus Creek being on one side of the Klamath River and Camp Creek a short distance above on the opposite side of the stream. Accordingly the two camps are operated under the name of Bogus Creek station.

KLAMATHON HATCHERY.

In order that the run of Chinook salmon in the Klamath River might be properly maintained, it was deemed essential that the department increase the extent of its operations with reference to this locality.

For many years past the Klamath River has been stocked each season with Chinook or king salmon fry, the supply being principally obtained from eggs taken from the Sacramento River. The United States Bureau of Fisheries had operated the egg-collecting station at Klamathon, and the eggs here taken were mostly shipped to Sisson, where they were hatched, reared, shipped back and planted in the Klamath River. The bureau also hatched some fry at Klamathon, and these fry were planted early in the spring. However, the station was not well equipped for general operations, the water supply was poor and uncertain, and consequently the extent of the operations was limited and the results obtained were far from adequate. After a careful

deliberation it was decided that some radical changes in the method of stocking the Klamath River must be undertaken. The matter was taken up with the Bureau of Fisheries and it very kindly agreed to turn the station over to the commission, donating also the use of most of the equipment, buildings, etc.

Construction of the racks, as a part of the Fall Creek Hatchery system, by the California-Oregon Power Company, was begun during the fall of 1918 and was finished in time to secure a small number of salmon eggs. Under the commission's plan of operation it was decided to take the eggs at Klamathon station and ship them to the new Fall Creek Hatchery, which was under construction at the same time, where they would be hatched, reared and planted in the Klamath River and tributaries. Nearly a million Chinook salmon eggs were secured during the fall of 1918, the first year of operation. During the fall of 1919 this station was prepared to operate at full capacity. Nearly 5,000,000 eggs were taken, despite the extreme drought, which materially affected the run of salmon in the Klamath River. The take of eggs has increased each year until, during the fall of 1921, a total of 19,000,000 eggs were procured. These eggs were all eyed at Mount Shasta and Fall Creek hatcheries, and the resulting fry were given the usual distribution.

KAWEAH HATCHERY.

Early in the spring of 1919 it was decided that to adequately stock the streams of Fresno, Tulare and a portion of Kern counties, a hatchery should be located in the most favorable situation in that district. Accordingly the proper investigations were made and a site located on the Kaweah River, near the town of Hammond, in Tulare County, chosen as the most favorable for the purpose.

The site is located on the property of the Mount Whitney Light and Power Company, on the main highway to the General Grant and Sequoia national parks, and has a water supply which is most excellent for hatchery purposes. It is the central distributing point for stocking the streams in that entire section. The location being all that could be asked for, an experimental station was established to determine the suitability of the water supply for fishcultural purposes. Three hundred thousand rainbow, 50,000 black-spotted and 100,000 steelhead trout eggs were hatched at the station during the spring. The resulting fry were reared to an advanced stage and were given a wide distribution in the streams of the Sequoia and General Grant national parks and the entire Kaweah River system during the months of August and September. The fry were strong and vigorous and at the time they were planted had attained an unusual size. It was demonstrated by the season's operations that the site selected was entirely satisfactory for the establishment of a permanent hatchery. The temporary hatchery has been operated each season, and will be until funds are available for putting up a permanent building.

SAN JOAQUIN EXPERIMENTAL SALMON HATCHERY.

The Kerckhoff dam, property of the San Joaquin Light and Power Company, that has recently been completed near Auberry's on the San

Joaquin, prevents the passage of the salmon to their former breeding grounds on the upper reaches of the river.

The Merced River will no longer afford a spawning ground for salmon, as a large irrigation project is planned that will hold back the flood waters of the Merced in a lake to be made by the construction of a high dam across the river near Exchequer. Plans had been made for the construction of fishways over the small dams in the Merced River, property of the San Joaquin Light and Power Company, and arrangements made for their construction, but the plan of the large irrigation reservoir makes it impracticable to attempt any further efforts to perpetuate the run of salmon in the Merced River. With the completion of the Kerckhoff dam and the proposed dam at Exchequer, the spawning grounds for salmon on the San Joaquin River and its tributaries are practically all cut off from the breeding salmon. During seasons of normal rainfall a few salmon will probably spawn near Friants, below power house No. 4 of the San Joaquin Light and Power Company. This area is very small and would not have any effect in keeping up the run of salmon in the river.

An experimental salmon-culture station was established on the San Joaquin River in 1921, with the object in view of determining what the expense would be of collecting the eggs near Friants in the fall and transporting them to the hatchery on Willow Creek, a distance of about thirty-five miles, hatching the eggs and rearing the fry in ponds, the fry to be held in the ponds until the following fall, then conveying them by auto truck to the river, below the Kerckhoff dam.

This plan proved impractical, owing to the inaccessible location of the site during the winter months and the great distance over rough roads which the green eggs would have to be carried in the fall. Plans are being made for the construction of a salmon-egg collecting station and hatchery on the San Joaquin River near Friants. This station will have to be constructed by the San Joaquin Light and Power Company, whose operations on the San Joaquin River have broken up the salmon run by the construction of high dams and the diversion of the water through a tunnel 17,000 feet long, through which the entire flow of the river passes during the summer months, leaving the bed of the San Joaquin River dry for a distance of twelve miles during the late summer and fall.

CONCLUSION.

This history should demonstrate that from small beginnings fishcultural operations have grown until California is a leader among the states in its output of trout and salmon. At the present time the state owns and operates thirty hatcheries and egg-collecting stations. Of this number, seven have been built within the last seven years. Each of the hatcheries is fully equipped and the largest one has a capacity of about 40,000,000 trout and salmon per year. Two railroad cars specially fitted for the transportation of the eggs and fry are maintained and operated to distribute the output. At several of the hatcheries auto trucks are utilized for short hauls to and from the railroad station, and in some cases for planting. In the maintenance of these hatcheries and egg-collecting stations, it is necessary to employ during the summer season nearly sixty men.

extent of the operations of the fishcultural department. Every effort has been made to keep pace with the demands of the situation, but there is a limit set by the proportion of the financial income of the commission which can be devoted to fishculture.

Mount Shasta Hatchery 1888 -
Clear Creek Hatchery 1918 -
Feather River Hatchery 1921 -
Eel River Egg Collecting Station 1920 -
Snow Mountain Egg Collecting Station 1907 -
New Tahoe Hatchery 1920 -
Mount Tallac Hatchery 1909
Wawona Hatchery 1895 -
Scott Creek Egg Collecting Station 1912 -
Brookdale Hatchery 1912 -
Mount Whitney Hatchery 1917 -
Cottonwood Lakes Egg Collecting Station 1918 -
North Creek Hatchery 1919 -
Metcalf Creek Egg
Pear Lake Hatchery
Grout Creek Egg Col-
lecting Station 1919 -

FIG. 39. Map showing location of present hatcheries and egg-collecting stations and year established.

HATCHERIES AND EGG-COLLECTING STATIONS, 1870-1921.

Name	Location	Years of operation
Acclimatization Society Hatchery	City Hall, San Francisco	1870-1871
State Hatching House	University of California, Berkeley	1870-1877
Baird Fish Hatchery (U. S. Bureau of Fisheries)	McCloud River, Shasta County	1873-
	(Rebuilt)	1881-1883
		1888-1920
Clear Creek Experimental Hatchery	Clear Creek, Lake County	1873-1874
Frazier Hatchery	Squaw Creek, Nevada County	1875-1880
San Leandro Hatchery	San Leandro, Alameda County	1878-1883
Hurley Hatchery	Tahoe City, Placer County	1880-1888
Woodson Egg Collecting Station	Fort Bidwell	1881-1884
Shebley Hatchery	Shebley's Station, Nevada County	1883-1888
Phipps Hatchery	Lake Tahoe, El Dorado County	1884-1888
Hat Creek Hatchery	Carbon, Shasta County	1885-1888
Mount Shasta Hatchery	Sisson, Siskiyou County	1888-
Tahoe Hatchery	Tahoe City, Placer County	1889-1891
		1894-1920
Fort Gaston Fish Hatchery (U. S. Bureau of Fisheries)	Trinity River, Hoopa Indian Reservation, Humboldt County	1889-1898
Shovel Creek Egg Collecting Station	Klamath River, near Beswick, Siskiyou County	1889-1912
Glen Ellen Fish Hatchery (private hatchery controlled by state)	Glen Ellen, Sonoma County	1890-1891
Del Monte Fish Hatchery (private hatchery controlled by state)	Del Monte, Monterey County	1890-1891
Bear Valley Hatchery	Olema, Marin County	1891-1894
Alma Fish Hatchery (private hatchery controlled by state)	Alma, Santa Clara County	1892-1893
Korbel Fish Hatchery (U. S. Bureau of Fisheries)	Redwood Creek, Mad River, Humboldt Co.	1893-1897
Independence Lake Fish Hatchery and Egg Collecting Station	Independence Lake, Nevada County	1893-1894
Redwood Creek Egg Collecting Station (U. S. Bureau of Fisheries)	Redwood Creek, Humboldt County	1893-1897
Battle Creek Fish Hatchery	Battle Creek, Shasta County	1895-
Wawona Hatchery	Wawona, Mariposa County	1895-
Mount Tallac Hatchery	Taylor Creek, El Dorado County	1896-1909
Price Creek Hatchery	Price Creek, Grizzly Bluff, Humboldt Co.	1897-1916
Ukiah Hatchery	Ukiah, Mendocino County	1897-
Mears Creek Egg Collecting Station	Near Sims, Shasta County	1898-1899
Hazel Creek Egg Collecting Station	Near Sims, Shasta County	1898-1899
Hornbrook Egg Collecting Station	Cottonwood Creek, Siskiyou County	1900-
Campbell Creek	McCloud River, Shasta County	1901
Squaw Creek	McCloud River, Shasta County	1901
Howe Creek Egg Collecting Station	Eel River, Humboldt County	1902
Mill Creek Hatchery (U. S. Bureau of Fisheries operated by state)	Los Molinos, Tehama County	1902-
California State Verdi Fish Hatchery	Verdi, Nevada State	1902-1905
Edgewood Experimental Station	Upper Shasta River, Siskiyou County	1906-1907
Snow Mountain Egg Collecting Station	Eel River, Mendocino County	1907-
Shasta River Egg Collecting Station	Yreka, Siskiyou County	1907-1908
Bouldin Island Bass Hatchery (striped bass)	Bouldin Island, San Joaquin County	1907-1909
Glen Alpine Hatchery	Glen Alpine Springs, El Dorado County	1908-1913
Bogus Creek Egg Collecting Station	Klamath River, near Hornbrook, Siskiyou County	1910-
Klamathon Egg Collecting Station	Hornbrook, Siskiyou County	1910-
Sacramento Experimental Salmon Hatchery	Sacramento	1911-1913
Brookdale Hatchery (operated by county, 1905 to 1912)	Brookdale, Santa Cruz County (operated by state)	1912-
Scott Creek Egg Collecting Station (operated by county, 1905 to 1912)	Scott Creek, Santa Cruz County	1912-
Willow Creek Egg Collecting Station	Thrall, Siskiyou County	1912
Camp Creek Egg Collecting Station	Siskiyou County	1912-

HATCHERIES AND EGG-COLLECTING STATIONS, 1870-1921—Concluded.

Name	Location	Years of operation
Bear Lake Fish Hatchery	Big Bear Lake, San Bernardino County	1914-
Gottville Egg Collecting Station	Siskiyou County	1914
North Creek Egg Collecting Station	Big Bear Lake, San Bernardino County	1915-
Burney Creek Egg Collecting Station	Near Burney, Shasta Co., on Pit River	1915
Ward Canyon Egg Collecting Station	Copco, Siskiyou County	1915
Fort Seward Hatchery	Alderpoint, Humboldt County	1916-
Mariette-Carson Hatchery	Carson City, Nevada (operated by California Fish and Game Commission)	1916-1917
Almanor Fish Hatchery	Almanor Dam, Plumas County	1916-1919
Yuba City Experimental Shad Hatchery	Yuba City, Sutter County	1916
Domingo Springs Hatchery	Chester, Plumas County	1916-
Rae Lakes Egg Collecting Station	Rae Lakes, Fresno County	1917-
Bryan's Rest Egg Collecting Station	Bryan's Rest, Humboldt County	1917
Mount Whitney Hatchery	Independence, Inyo County	1917-
Yosemite Experimental Hatchery	Yosemite, Mariposa County	1918-1920
Cottonwood Lakes Egg Collecting Station	Cottonwood Lakes, Inyo County	1918
Clear Creek Hatchery	Westwood, Lassen County	1918-
Feather River Experimental Hatchery	Grey Eagle Creek, Plumas County	1918
North Creek Hatchery	Big Bear Lake, San Bernardino County	1919-
Fall Creek Hatchery	Copco, Siskiyou County	1919-
Kaweah Hatchery	Hammond on Kaweah River, Tulare Co.	1919-
Metcalf Creek Egg Collecting Station	Big Bear Lake, San Bernardino County	1919-
Bull Creek Egg Collecting Station	Dyerville, Humboldt County	1919
Grout Creek Egg Collecting Station	Big Bear Lake, San Bernardino County	1919-
Warner Creek Egg Collecting Station	Plumas County	1920
Eel River Egg Collecting Station	Branscomb, Mendocino County	1920-
New Tahoe Hatchery	Tahoe City, Placer County	1920-
Feather River Hatchery	Johnsville, Plumas County	1921-
San Joaquin Experimental Station	Auberry	1921

FISHCULTURAL DEPARTMENT PERSONNEL.

By Harold C. Bryant.

The fishcultural work of the state gained its initial impetus from the first commissioners, appointed in 1870, Messrs. B. B. Redding, S. R. Throckmorton and J. O. Farwell. Because of their interest in stocking the streams with desirable food fishes, the hatching and rearing of fish received due encouragement. The first fishculturist retained by the commission was Mr. J. G. Woodbury, who had been carrying on experiments in fish breeding for the California Acclimatization Society, and later for the United States Fish Commission. Mr. Woodbury devoted nearly twenty years of his life to the interests of fishculture in California. His principal work was done at Berkeley and San Leandro, where trout and salmon were reared, and at Clear Lake station, where the propagation of whitefish was attempted. Mr. Woodbury became first assistant to Dr. Livingston Stone at the time the government salmon-breeding station on the McCloud River was established in 1872. He was made State Superintendent of Hatcheries in 1888, and during the same year, with the assistance and advice of Dr. Livingston Stone and United States Commissioner Marshal McDonald, he located the Sisson Hatchery. The following year he located the hatchery at Tahoe City.

In 1891, desiring to engage in private business, Mr. J. G. Woodbury resigned as superintendent of hatcheries. In 1893, the board appointed Mr. John P. Babcock to fill the newly created position of chief deputy of the California Fish Commission, in which capacity Mr. Babcock acted from 1893 until 1901, when he resigned to accept a position with the government of British Columbia.

The successful transportation of eggs and fry from Eastern states in the seventies was due to Dr. Livingston Stone, a fishculturist of the United States Fish Commission. On each of the several difficult transcontinental trips Dr. Stone proved that he understood the care of fish. As much of acclimatization work was a cooperative project by the United States Fish Commission and the California Fish Commission, Dr. Stone was at times under the employ of the California commission. This was true also when he became superintendent of the McCloud River Hatchery, for the California commission bore a portion of the cost of hatching and planting the salmon.

Mr. J. A. Richardson, who had been employed by the United States commission at the Baird Hatchery, and who was an assistant at the San Leandro Hatchery, was made Superintendent of the Shebley Hatchery when it was built in 1883. Mr. Richardson resigned in the fall of the same year, and Mr. I. C. Frazier was appointed to succeed him. Mr. Frazier was a successful and competent fishculturist, who had been a student of fish life for a great many years. In the early seventies he associated himself with some of the acclimatization societies and later established a hatchery, with rearing ponds, on the Truckee River. In 1884, owing to ill health, he resigned as superintendent of the Shebley Hatchery, and Mr. J. V. Shebley was appointed superintendent. In 1885, Mr. J. V. Shebley was appointed Superintendent of Hatcheries, and Mr. W. H. Shebley succeeded him at the Shebley Hatchery. Mr. Frazier later became superintendent of the Tahoe Hatchery, and Mr. Richardson was again employed as an assistant.

When the Sisson Hatchery was built, in 1888, Mr. J. A. Richardson was appointed superintendent, and he managed the station until 1893, when Mr. W. H. Shebley succeeded him. The largest hatchery in California, and in some respects the largest in the United States, was for twenty-one years under the efficient supervision of Mr. W. H. Shebley. As superintendent he demonstrated that millions of trout could be successfully reared each year without serious loss.

The pioneer work of introducing the first shipments of trout in the barren waters of the Yosemite region was carried on by Mr. Shebley, who introduced the first fish in the waters above the valley in 1892.

In November, 1911, the commission created the office of fishculture and distribution, and Mr. Shebley was assigned to this new division of the work. A successful organization of this department was soon accomplished, with the division of screens and fishways, as part of the department of fishculture. As the duties of this work required Mr. Shebley to be away much of the time, Mr. R. W. Requa was made assistant superintendent of the Sisson Hatchery, and he very ably assisted in conducting the work of the station. Being a skilled mechanic, Mr. Requa invented and perfected the rotary type of screen used in irrigation ditches.

The success of early experiments and the efficiency of the present fishcultural department have been due largely to the untiring care and energy of Mr. W. H. Shebley. There is no one in America who possesses greater knowledge of fishcultural methods. Present fishcultural methods and the system of rearing ponds installed at the Mount Shasta Hatchery will always be a monument to his ingenuity.

On March 1, 1916, the office of the department of fishculture was transferred from Sisson to San Francisco. Extensive fishcultural operations demanded a more centrally located section. Mr. E. W. Hunt was appointed field superintendent of the department of fishculture, and Mr. J. H. Hoerl chief clerk. Mr. Shebley was succeeded as superintendent of the Sisson Hatchery by Captain G. H. Lambson, who for seventeen years was superintendent of the United States Bureau of Fisheries stations in California.

The hatcheries at Lake Tahoe were for twenty years under the supervision of Mr. E. W. Hunt, who is a fishculturist of long standing and a man of keen business ability. The results of his management are evident now in the well-stocked lakes and streams of the region. Since 1916 Mr. Hunt, as field superintendent, has done most of the inspection and advisory work at the various hatcheries.

The work at Ukiah was for many years very capably handled by Mr. A. V. La Motte.

For many years Mr. M. L. Cross had charge of the Wawona Hatchery and directed the distribution that has placed trout in hundreds of miles of streams and thousands of acres of lakes in the previously barren areas lying above and beyond the Yosemite Valley. As a hatchery man, his work was always above criticism.

For many years previous to his death in 1918, Mr. F. A. Shebley was a trusted fishculturist of the commission. He was the son of California's first famous fishculturist, and had succeeded before his death, in company with his brother, William H. Shebley, in making a reputation in the same line of endeavor as great, if not greater, than that of the father who had gone before. As a boy he followed farming on his father's place, but for twenty-five years he was identified exclusively with fishculture in connection with the California Fish and Game Commission, and there were few men on the Pacific slope who knew as much about fish and fishing in the waters of the rivers and bays as he. At various times he was superintendent of the Price Creek hatchery in Humboldt County and the Brookdale Hatchery in Santa Cruz County, and later the new Mount Whitney Hatchery in Inyo County. Under his management the Brookdale Hatchery became very popnlar and was sought out by sportsmen from all over California as a place of great interest. Also interested in angling as a sport, he was a master of the fly rod and a skilled angler.

In 1900 Mr. W. O. Fassett was appointed superintendent of Eel River Hatchery, and under his management the station was a continued success. In more recent years Mr. Fassett has had charge of all of the fishcultural operations along the north coast.

In October, 1901, Mr. Charles A. Vogelsang was appointed chief deputy of the California Fish and Game Commission, following the resignation of Mr. J. P. Babcock. During the administration of Mr. Vogelsang as executive officer of the commission (1901–1910) a number

of practical improvements were put into effect; the Sisson and the Tahoe stations were enlarged and improved; the hunting license law was passed, which placed at the command of the commission an increased amount of funds that could be devoted to the propagation and protection of the fish and game; the fish-distributing car was built; the game farm was established, and other improvements were made. In the carrying out of all of this work Mr. Vogelsang took an active part. He resigned in 1910, but was reappointed executive officer in 1920 and held that position until March, 1922.

There have been many other faithful hatchery employees, but their years of service have been more limited.

THE RETURN OF MARKED KING SALMON GRILSE.

By J. O. SNYDER, Stanford University.

Twenty-three marked king salmon grilse were taken at the Klamathon racks last fall. This is the first result of a marking experiment initiated in 1918 by W. H. Shebley, in charge of fishculture. A complete account of the marking of these fish, as published in CALIFORNIA FISH AND GAME, July, 1920, may be summarized here. From king salmon eggs taken in Mill Creek, a tributary of the Sacramento River, in November, 1918, and hatched at Fall Greek Hatchery on Klamath River in February, 1919, 250,000 fish were placed in a rearing pond. In November, 1919, these were liberated in Klamath River, after 25,000 of them were marked by removing the adipose and right ventral fins (Fig. 40). It appears that the marking was successfully accomplished and that the fish were liberated under the best conditions. Some of these were expected to return as grilse in 1921, and later as older fish.

The marked fish appeared at Klamathon, where they were stopped by the racks, from October 24 to November 14, when the last one was taken. Of the last ones secured, Captain Lambson remarks, "Two were in very fine condition, as if lately from salt water." These fish measured from 15½ to 24½ inches to the end of the middle caudal rays. All were mature males.

Scales of these marked fish, together with mutilated fins, were carefully preserved by E. V. Cassell, foreman of the Fall Creek Hatchery. This material and a considerable amount of necessary data were assembled and forwarded to the writer by Captain G. H. Lambson. Therefore the record of each specimen is accurate and complete.

A photomicrograph of a scale of one of these grilse is here presented as figure 43. An examination of this scale will reveal some peculiarities of structure. It will be seen that a well-defined inner part or nucleus, A, is composed of 11 or 12 concentric rings or circuli, which are closely apposed and in some places broken or branched. Outside the nucleus and surrounding it is a broad area of more-regularly formed circuli, which are at the same time much wider. This area, which may be designated A-D in the figure, is bounded at D by a crowded condition of the circuli. Beyond this area is a third region, D-E, the circuli of

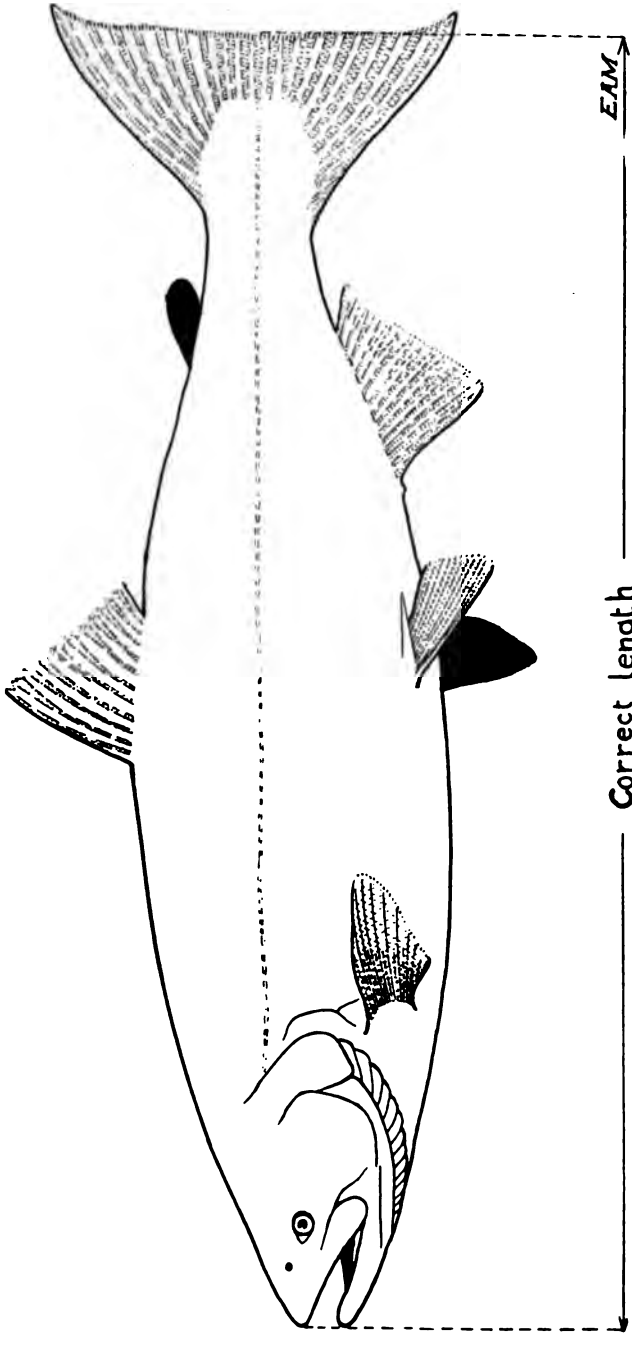


FIG. 40. Outline drawing of king salmon, showing method of marking in experiments by the removal of the adipose and the right ventral fins.

which are still wider than the others. This region extends to the edge of the scale, which is rough and broken. In the area marked A-D the circuli are not altogether homogeneous in character, for at B and also at C, two or three of them are closely apposed or narrower than the others. These are the principal structural features of this particular scale.

Scales from the other marked grilse possess very similar characteristics. These present the same type of nucleus, which is surrounded by two distinct outer areas, the inner of which is much like that of the scale just described. The nucleus, when followed through the entire series of 23 scales, is seen to possess the same closely crowded or narrow circuli, although they vary in number from 8 to 14. The area designated

FIG. 41. The racks at Klamathon, between which the returning grilse were trapped. Photograph by E. A. McGregor.

as A-D is in cases wider or narrower, but it preserves more or less definitely the same features. The outer area, D-E, varies greatly in width, in some cases being scarcely represented. The irregular edge and the variable width of this outer area are due to absorption which the scale has undergone, it having suffered as have some other tissues of the body during the long and difficult migration from the sea, which was performed without food. In grilse taken at the mouth of the river this portion of the scale is perfect, as is illustrated by figure 44.

It will be of interest to attempt an interpretation of some of the structural features which are apparent in these scales, even in the face of the possibility that such interpretation may not be wholly supported by additional data which it is hoped the future will provide, In the

first place, we know that the fish is in its third year, and by the application of the well-tested criteria of investigators of scale growth, it may be safely stated that the nucleus represents roughly the growth of the first year, the area A-D that of the second, and D-E the third, a part of the latter having been effaced by absorption.

The nuclear growth record as traced in these scales is exactly duplicated by that of scales removed from some small yearlings of the same lot at the time of their liberation. Such scales are represented by figure 46.

The nucleus of the scale represented by figure 43 is much like that of a naturally spawned fish which has spent its first year in the river.

FIG. 42. Spawning operations at Klamathon. E. V. Cassell, taking eggs from a female king salmon. Photograph by E. A. McGregor.

A scale that is believed to be of such an individual is represented by figure 44. This type of nucleus is very different from that of a salmon which entered the sea at an earlier period in its life, near the time that scales make their appearance. A scale of such a fish which was taken in its third year is shown in figure 43, where the first year's growth extends to A.

Attention was directed to the lack of homogeneity in the area A-D, which is presumed to represent the growth history of the second year. Two very evident intermediate checks appear, one at B, the other and later one at C. The area enclosed by the check B is composed of circuli which are somewhat narrower than the others, possibly characteristic of slower growth. It might be presumed that this area is one of river growth, attained while the fish lingered in the estuary, where food

abounds. It is not strictly characteristic of estuary growth, however, as illustrated by fish taken at or near the mouth of Klamath River. In the latter part of August, and probably much earlier, yearling salmon appear in the estuary, where they linger and grow very rapidly. Some specimens measuring 200 millimeters and looking much like miniature salmon from the sea were collected in September. A scale from one of these is shown in figure 47. In this scale a nucleus, A, is apparent, which is surrounded by an area of wider circuli. From facts learned from observation of these fish, this region is undoubtedly representative of estuary growth, and a comparison of this with the area A-B would scarcely lead to a similar interpretation for the latter. It seems more probable that after being liberated this fish hastened on his long journey to the sea, growing very little, if any, on the downward passage.

While in the sea during the second year, two checks in growth occurred, due to what cause we have no means of knowing. Near the end of the second year a check normally appears. This is represented at D. Abundant material from Monterey Bay shows that this check usually develops in the winter or early spring, not appearing in all individuals at the same time.

The intermediate checks offer nothing remarkable, as somewhat similar characters may be easily found in any large assemblage of king salmon scales. They might be passed over as indicating that some event in the life of the fish, temporary scarcity of food, for example, had served to interrupt or check its normal growth at a particular time. But in this they deserve further consideration, as will appear.

Of the twenty-three marked salmon which were recovered, no less than seventeen possessed scales which in every essential detail were like that illustrated in figure 43. That the nuclei should be much alike occasions no surprise, for all were reared alike, and consequently environmental conditions were similar for all while the nuclear growth progressed, but that this detailed resemblance should continue in such a marked way through the second year is worthy of attention.

Under an hypothesis that the growth of the fish is reflected by the growth of the scale, and that growth is influenced by environment, the assumption follows that all of these fish must have been in contact with the same environmental conditions during the second year. It would appear not at all improbable that they schooled together. This suggests the possibility that associations formed in the stream may continue in a large measure throughout life in the sea. The four-year fish of this marking, if any are caught, will furnish additional data of interest in this connection. They will also bring a record of the third year, which in these grilse is largely effaced.

Scales of the remaining marked fish differ in a minor degree only from the others by having a more or less well-defined check about half way between those marked B and C in figure 43.

As 250,000 fish were liberated, of which 25,000 were marked, the return of ten unmarked individuals with every marked one might be expected. Unfortunately, scales were preserved from very few unmarked grilse while the marked ones were being taken. However, among those that were preserved are two which show the same characteristic scale structure as the marked ones. A photomicrograph of one

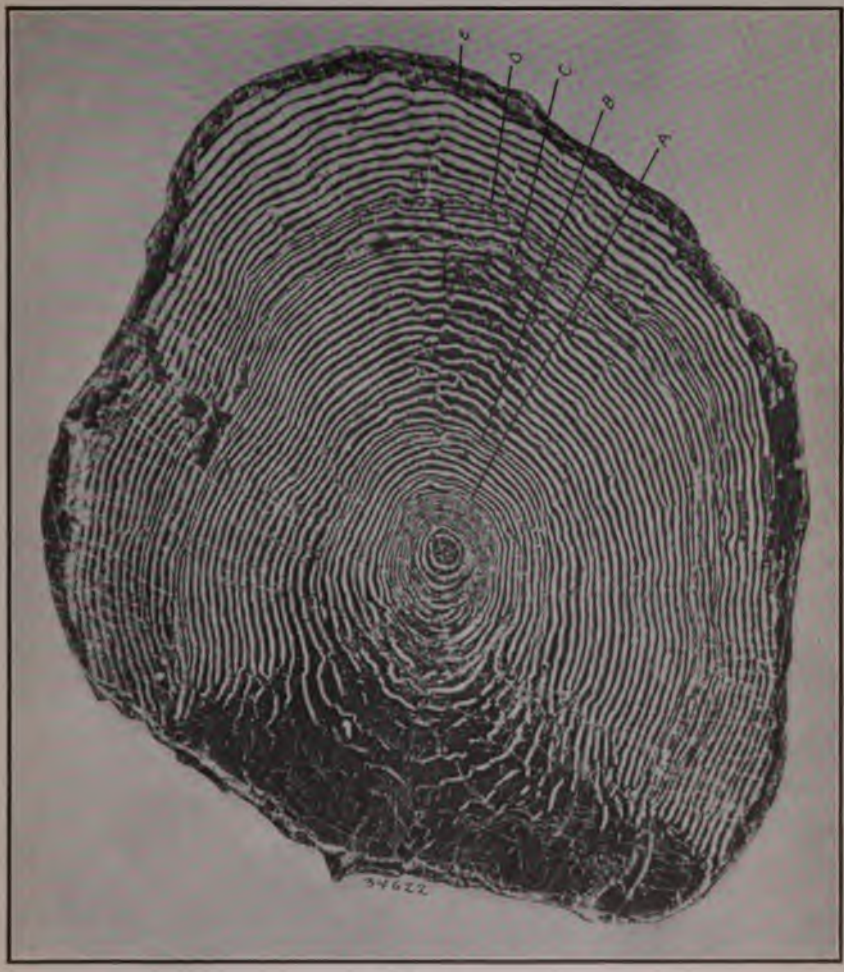


PLATE I.

FIG. 43. Photomicrograph of a scale of a marked king salmon grilse which returned to Klamathon racks in 1921.

PLATE II.

FIG. 44. Scale of a male king salmon in third year. From Klamath Estuary.

PLATE III.

FIG. 45. Scale of a male king salmon in third year; ocean type of nucleus.

FIG. 46. Scale of a yearling king salmon 84 millimeters long. One of a marked lot of fish which was preserved at the time the others were liberated.

FIG. 47. Scale of a yearling king salmon measuring 200 millimeters, showing estuary growth.

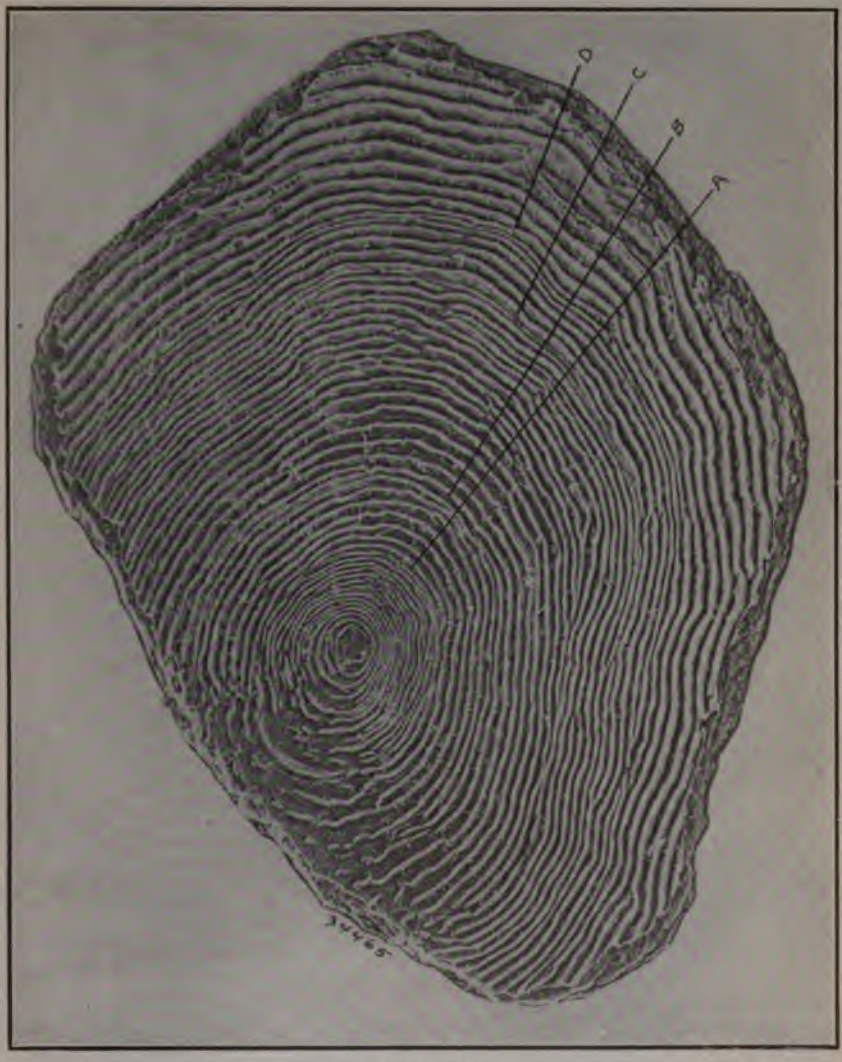


PLATE IV.

FIG. 48. Scale of an unmarked grilse which was liberated with marked ones in Klamath River.

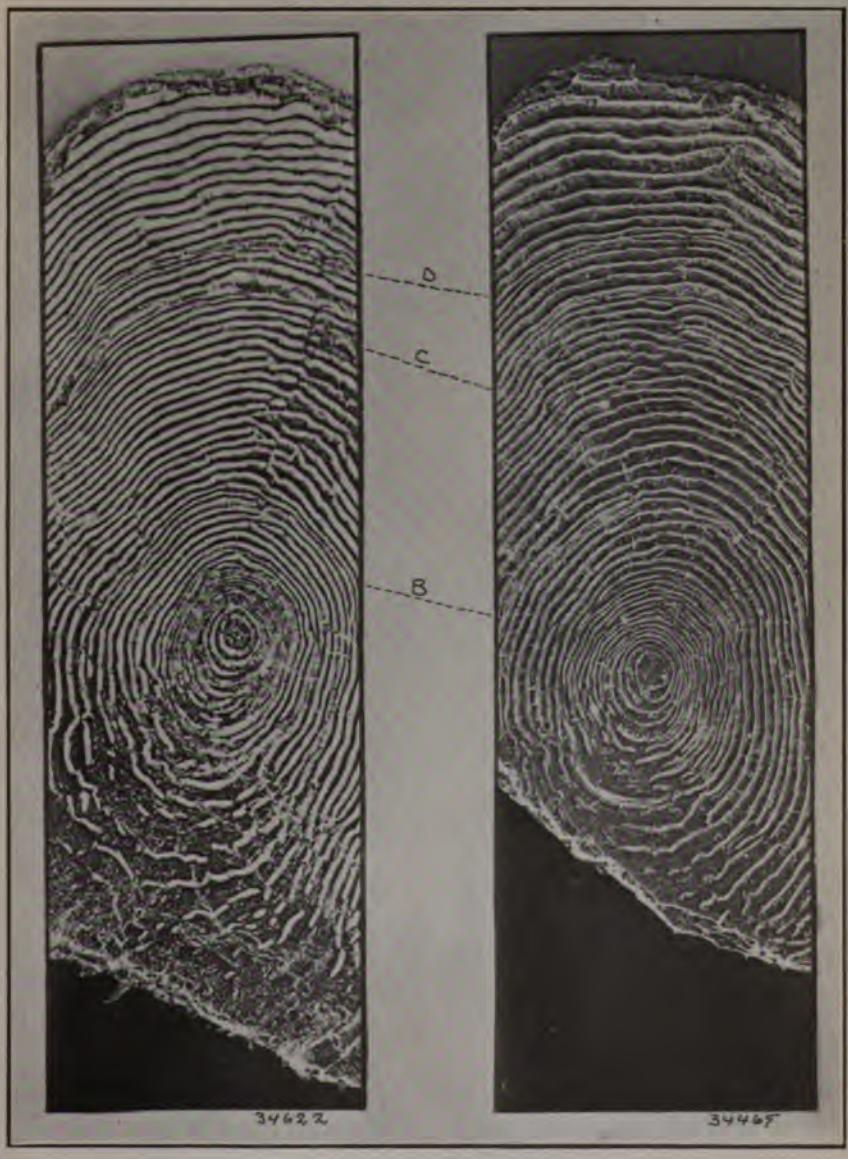


PLATE V.

FIG. 49. Scales of marked (34622) and unmarked (34465) king salmon grilse which returned to Klamathon racks in 1921.

PLATE II.

FIG. 44. Scale of a male king salmon in third year. From Klamath Estuary.

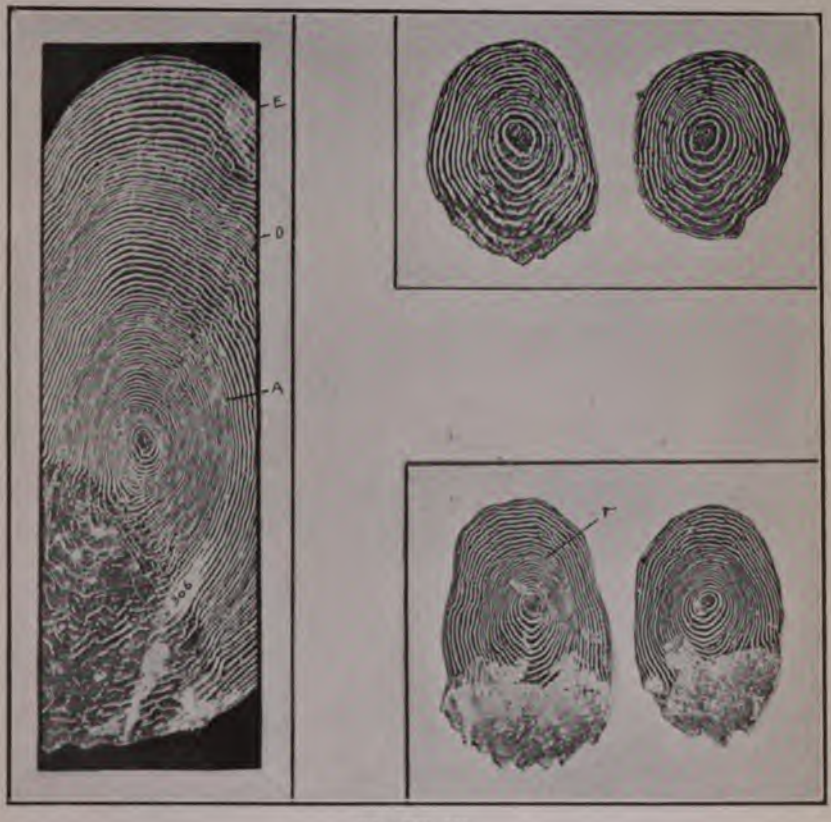


PLATE III.

FIG. 45. Scale of a male king salmon in third year; ocean type of nucleus.

FIG. 46. Scale of a yearling king salmon 84 millimeters long. One of a marked lot of fish which was preserved at the time the others were liberated.

FIG. 47. Scale of a yearling king salmon measuring 200 millimeters, showing estuary growth.

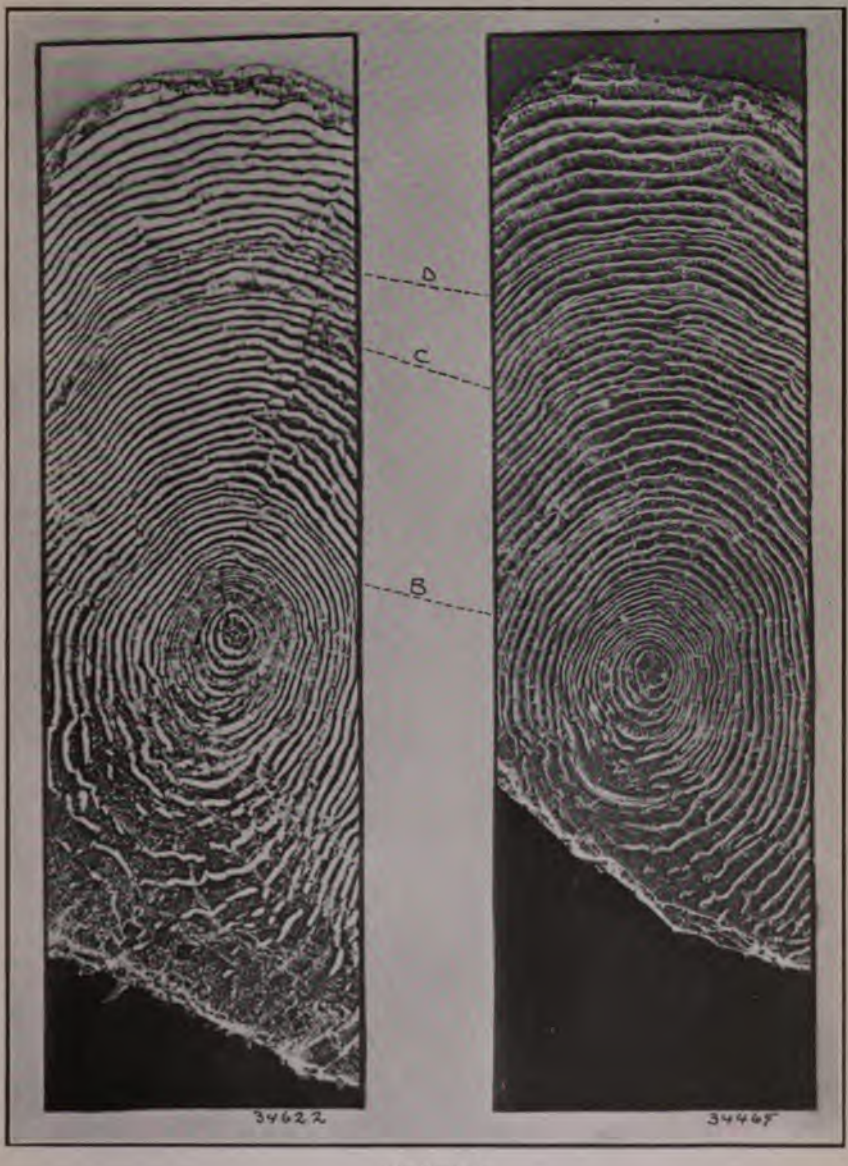


PLATE V.

Fig. 49. Scales of marked (34622) and unmarked (34465) king salmon grilse which returned to Klamathon racks in 1921.

PLATE VI.

FIG. 59. Scale of a five-year-old marked king salmon recovered in Klamath River in 1919.

THE WHY AND HOW OF MOUNTAIN LION HUNTING IN CALIFORNIA.

By JAY BRUCE, State Mountain Lion Hunter.

The importance of the control of the mountain lion (*Felis concolor*) as an aid in game-conservation can be appreciated when it is realized that the present lion population of California is scientifically estimated to be about 600 lions, and their annual kill of deer 30,000 head. This is over twice the number known to be killed by human hunters. Since does are probably about five times as numerous as bucks, a lion has five chances to kill a doe for one chance to kill a buck. So, naturally, most of the deer killed by lions are the breeding stock of females.

Although deer form their principal food, lions also kill thousands of dollars worth of domestic stock every year, even including full grown cattle. In fact, no animal in California is entirely exempt from the bloodthirsty instincts of these animals. I know definitely of lions having killed and eaten foxes, skunks, coons, porcupines and bobcats. I also have reliable information of several instances where lions have killed and eaten domestic dogs, while two lions now in captivity in the Yosemite Valley killed and ate a cub bear which managed to get into the lions' cage from his own adjoining cage.

The lion problem has been intensified by the establishment of a chain of game refuges where no public hunting is allowed. The breeding stock of deer and other game is fast increasing in these areas, and naturally the lions accumulate there. Since the lion's instinct is to kill at every opportunity, the most damage will be done where deer are most numerous.

In order to meet this condition a high state bounty was advocated. It seemed doubtful, however, whether a $100 bounty would attract enough hunters to confer a benefit anywhere in proportion to the additional cost, as will be shown later. Another method of control considered was the employment of experienced lion hunters on a regular salary, plus the present bounty. As an experiment along this line the writer was employed by the California Fish and Game Commission, on January 1, 1919. This system costs only about $2000 per year, as against the $15,000 by the increased bounty, and lions are killed where there is the most need of killing them. The main object of the plan adopted was to control the lions in game refuges, and then to answer any calls where lions were doing unusual damage. During the last three years I have accounted for ninety lions, as follows: 1919, twenty-six lions; 1920, thirty lions; 1921, thirty-four lions. Most of these were taken in and around game refuges. Since October, 1908, the California Fish and Game Commission has been paying a bounty of $20 for each mountain lion killed. Claims for such bounty are made on blanks furnished by the commission, and every claimant has been requested to furnish the commission with a written statement showing where the lion was killed, why it was killed, the damage done by the

NOTE.—There have been few articles appearing in CALIFORNIA FISH AND GAME of more general interest than the one offered here, written by a man who probably knows more about the habits of the mountain lion than any other Westerner. In bagging 121 lions, Mr. Bruce has traveled on foot over 10,000 miles, hunting, trailing, and studying their habits.—EDITOR.

lion, methods used in taking him, and the sex of the animal. In July, 1917, the bounty on female lions was raised to $30 per head.

The information sent in by claimants for bounty indicates that nearly all of these lions were killed either accidentally or because they were doing damage to stock, and not on account of the bounty. Now if the bounty were raised to $100 per lion, the state would be paying $75 more on an average for each lion now killed under the present bounty, and this would amount to about $15,000 annually.

From the foregoing it might be argued that the present bounty is useless and should be abolished, so let us examine and see what benefit

FIG. 51. One hundred and fifty pound male lion treed near Lynchburg ranger's station, Placer County, November 1, 1921.

is derived from this expenditure. It is evident that no situation can be handled intelligently or with efficiency without accurate data as a basis for action. Now on account of the bounty of $20 paid since 1908, the commission has been furnished with the following data:

The number of lions killed during the last thirteen years;

The proportionate number of these killed from year to year under a given condition, which should indicate the comparative lion population;

The damage known to have been done by each lion;

The methods used in taking the animal;

The percentage of each sex killed since 1917.

These data are of immense value in any effort to control the lion, and are now being used to advantage for that purpose by the commission. For instance, we find from an examination of these data that the range of the lion on the western slope of the Sierra Nevada Mountains between Siskiyou County and Kern County, is confined to a straight belt about fifteen miles wide by section lines, and at an elevation between 3000 and 5000 feet above sea level and averaging 4000 feet. The same elevation will apply to the range of the lion in the Coast

Range Mountains. All the country above or below this belt can be eliminated as lion country for all practical hunting purposes.

The lion does not habitually follow some of the deer to the higher mountains in summer and other deer to the foothills in winter, as many people suppose. This lion belt is so well defined in the Sierra that we can draw a straight line through the center of the belt, from a point in Siskiyou County to a point in Kern County, and it would be possible for a hunter to camp along this line and kill approximately every lion on the western slope of the Sierra. Of course a lion will occasionally stray out of this belt temporarily, but he soon returns, for his natural home is there. The lion probably selects this belt because it is the natural home of the deer. The variety of *ceanothus*, commonly

FIG. 52. A large 160-pound male lion which measured 7 feet 3½ inches. Killed near Avery, Calaveras County, in March, 1921. Photograph by L. V. Peterson.

called deer brush, which is the principal food for deer, grows in abundance in this belt between 3000 and 5000 feet elevation. The deer that summer higher winter here, and those that winter below summer here. Most of the deer stay here all the year, so this area is the best all-year range for them. In other words, the maximum deer population is to be found in this area. For this reason the lioness selects some place in this belt when her young are to be born. She usually has two or three kittens, although sometimes only one, and occasionally four, are born in a litter. On account of many females not mating every year, the yearly increase probably averages one kitten for each adult female. The lair is usually located around some bluff or pile of rocks, which furnishes places for shelter and concealment of the kittens when small.

In my experience, the kittens are born in either February, April, August or November. The mother nurses them for about two months, and probably brings them some food in her stomach during that time.

After they are weaned she makes a kill and moves the kittens to it, leaving them to eat it while she goes away hunting. She continues moving the kittens from kill to kill until they are about six months old and weigh about 35 pounds for females and 50 pounds for males, by actual scale weight. They now hunt part of the time with their mother until they are about a year old and weigh about 65 pounds for females and 80 pounds for males. The mother then abandons them. The kittens sometimes continue to hunt together for a few months longer, when they finally separate, selecting different beats, but still in the same belt where conditions are the same as where they were raised.

When fully matured the male weighs from 140 to 160 pounds and measures from 6½ feet to 7½ feet from tip of nose to tip of tail. The female weighs from 90 to 105 pounds and measures from 6 feet to 7 feet from tip to tip. These are actual scale weights and tape measurements.

The adult male accompanies the female only during the mating period and does not help to feed and care for the young. Lions do not make their kills by lying in wait on the limbs of trees and springing from there. In fact, I have never known of a lion climbing a tree except to avoid the dogs. They tirelessly hunt and stalk their quarry on the ground, taking advantage of every cover, and finally rushing from a distance of 40 or 50 feet. This distance is covered in about a second. A 100-pound lion moving at a velocity of 40 feet per second will strike a blow sufficient to prostrate a yearling steer. The heavy muscles of the lion's neck, shoulder and forepaws are tense for the blow, and easily absorb the shock that prostrates his unsuspecting victim, which is then killed by being disemboweled. The liver is eaten first, and then the loins and hams. An examination of probably 100 deer killed by lions showed no evidence of the lion having touched the throat of any of these kills.

I have found the lion to be normally a solitary and invariably a silent animal. I have never heard that hair-raising scream the lion is supposed to utter, and I do not believe it makes any loud sounds, but that the noises usually attributed to it are made by owls and coyotes. On one occasion of which I know, about fifty guests at a mountain resort were listening one evening to the braying of a mule colt, and were told in good faith that they were hearing a mountain lion scream. Every one of these people, including their informant, probably believes to this day that they were hearing a lion.

Some writers have condemned the mountain lion as being cowardly and unwilling to attack in the open, but they lose sight of the fact that the cat family is short-winded and unable to capture its prey by running it down as the dog family does. If the lion should openly approach his prey and challenge it to combat, his intended victim would immediately take to flight, leaving the lion to go hungry. His only means of making a living is to surprise his quarry. In a fight to the death, the mountain lion is more game than the black bear. He will fight with his last breath, when the black bear will quit and cover his head with his paws and bawl like a calf.

The most reliable method of taking lions is trailing with dogs, and the best dogs for this purpose are fox hounds. A hunter requires at least four dogs, which must be highly trained on lions and thoroughly proof on deer and other game, as there are probably a thousand head

of deer and other game combined, for each lion. The dogs are used in pairs, allowing each pair to rest every second day, as a dog uses so much energy in running, baying and wagging his tail during ten or twelve hours of trailing that he needs one day's rest for each day of work. Furthermore, a dog's feet will not stand continuous hunting.

To be successful, lion hunting must be done intensively. Since a lion does most of his prowling at night, the hunter must leave camp early and travel fast, in order to find a fresh trail and have the most hours of daylight to trail the lion down, as a person can neither travel to advantage in the mountains after dark, nor see tracks when necessary to help the dogs. A lion travels a regular beat over about 100 square miles, usually making his round about every four or five days, so as soon as some part of this beat is learned, the hunter has a clue to

FIG. 53. Mountain lion scratches.

work by. Since the dogs can smell only a reasonably fresh track, the hunter can not depend entirely upon their sense of smell to find the trail, but must always watch the ground carefully for any old signs which would indicate the places where a lion had been traveling.

The signs left by lions are fresh or old kills, dung and tracks, and if a male is traveling a beat the plainest sign will be marks about a quarter to a half mile apart along the beat and apparently made by the lion digging with his forepaws in the dead leaves near the base of a tree or in the rotten wood near an old log (see figure 53). These marks *are all alike* and can not be mistaken for anything else when once *learned; they* are made only by the male and are a sure indication to

the hunter of the sex of the animal he is trailing. After some part of the lion's beat has been learned, that part must be hunted first every day, continuing the hunt then from there. If one day is missed and the lion passes, the track may be too old for the dogs when it is found the next day, and this may mean four or five days before the trail is again found fresh enough for the dogs to follow. A dog can not follow any but a very fresh trail on hot and dry ground or in dust, so the hunter must use his eyes to help the dogs past such places. In the cool, damp weather of winter a twenty-four hour trail can usually be successfully followed, while in the hot, dry weather of summer a six-hour trail is found difficult. When snow is on the ground, trailing is

FIG. 54. Doe and fawn killed by mountain lion near Bear River on north fork of Mokelumne River.

easy and a four or five-day-old track should be followed, as a lion may make a kill at any point on his beat and may have returned for a feed, allowing the hunter to get a fresh track at the kill. I estimate that while killing 120 lions I advanced an average of about fifteen miles the day the lion was killed. This distance does not take into account many loops made in looking for tracks when it was necessary to help the dogs. Many times I have trailed a lion this distance each day for three or four days before bagging him. Several times I have advanced twenty-five miles, and once thirty miles, the day I got the lion. Generally the hunter travels on foot over 100 miles for each lion killed. I estimate that on the average trail my dogs will travel about five times the distance advanced. To me it is very interesting to watch a hound on the trail. He rushes along with nose close to the ground, head sweeping from side to side and tail wagging furiously, stopping suddenly as he catches the scent, smelling intensely for a moment to make sure, then throwing up his head and baying loudly as he rushes ahead for a hundred feet or so, then trying again for the scent, and circling until *the trail is located.* Now another rush ahead, and so on for *twelve or fourteen hours,* or until the constant baying indicates that

the lion has been routed out of his bed and is making away, with the dogs in close pursuit. The hunter knows when the lion is finally treed, by the changed note in the baying of the dogs and by the fact that the baying comes continually from one place. On arriving at the tree, he can see anywhere from 100 to 160 pounds of cat, standing among the branches, usually about 30 feet above the ground. The lion may be just watching the dogs with interest, or he may be very angry, which is indicated by his constant growling.

At the crack of the gun, out he goes, and even though shot through the heart he may still be able to seriously injure a dog. For this reason it is best to tie the dogs before shooting.

It is quite an exciting experience to see a wounded adult lion on the ground, trying to hold at bay from two to four frantic dogs. Every moment will be full of action, as the dogs attack from different directions and the lion continually turns to meet each attack. All the while he is growling and spitting savagely, his ears flat back, mouth wide open, claws unsheathed and hair and tail standing up. If the dogs crowd him too closely he turns over on his back and fights with his mouth and all four feet at the same time. Now is the time for the hunter to rush into the fray, shove his gun between the frantic dogs and get in a fatal shot.

BLACK BASS SHIPMENT TO MEXICO.

By GEORGE NEALE, Executive Officer, California Fish and Game Commission.

In 1909, at the request of the Mexican government, Mr. Chas. A. Vogelsang, at that time chief deputy of the California Fish and Game Commission, made arrangements for the shipment of black bass to Lake Chapala, Mexico.

The California Fish and Game Commission's distribution car No. 1, in charge of the writer, left Fresno early in December, 1909, with ninety-two cans containing about 1800 adult black bass. Some weighed as much as three pounds. After many delays, Ocotlan, on the shore of Lake Chapala in the Mexican state of Jalisco, was reached. Here the first planting was made. Seventy-two cans were transferred to lighters, which were towed by launches to the south end of the lake, where the fish were liberated. Some of them immediately began feeding on the minnows.

We were then taken to the governor's palace on the shore of Lake Chapala, and were lavishly entertained by Governor Landa. Accompanied by the governor's quartette of guitarists, we returned to Ocotlan after midnight in a terrific blow.

Lake Chapala is a magnificent body of water, larger but not so beautiful as our own Lake Tahoe. It contains a food fish known as the whitefish, which differs from our whitefish in that it is transparent. But it furnishes a fine food for the black bass, which food is most necessary to insure increase. Lake Chapala is also said to contain carp, but we did not see any. This lake should now (eleven years after the planting of these black bass) be an anglers' paradise for those who know how to lure the fish, which are, as Dr. Henshall states, "inch for inch, pound for pound, the gamiest fish that swims."

Our next stop was at a small lake a few miles north of Mexico City, in which we planted twenty cans of black bass. We accomplished all this with the loss of but two fish.

We were met at Mexico City and taken to dinner at the magnificent restaurant "Chapultepec," at the foot of the castle of the same name, which once was the home of Montezuma. We quartered at the St.

FIG. 55. Planting black bass in Lake Chapala, Mexico.

Francis Hotel, then a magnificent hostelry of the old Mexican type, and were royally entertained by the government. While there an amusing incident occurred, which illustrates the manner in which we were entertained. After signing the meal check, showing what we had received and the cost of the same, which was paid by the Mexican government, our interpreter came to us and said, "We observe there is no wine or liquor charged. Is it because you do not drink wines or liquors, or do we not have the kind you are used to drinking? If not, we will get the brands you care most for." We thanked him and

FIG. 56. Scenes at a bull fight at which employees of Fish and Game Commission were guests after conveying California black bass to Mexico City for planting.

assured him that nothing but our modesty had prevented us from ordering the most select wines.

Automobiles were placed at our disposal. The Christmas festivities were in full blast, and we had special seats for the opera, "The Merry Widow," also seats at the bull fight, which was attended by President Diaz and 48,000 people. We shall always wish to forget the bull fight. We were unable to leave the arena, so were compelled to witness some of the most shocking brutality and cruelty ever perpetrated. Thirteen magnificent bulls were slowly tortured to death. Eleven horses were gored and dragged out of the arena alive, their entrails protruding, amid the plaudits of 48,000 representative citizens. It is puzzling to know that people possessing such qualities of refinement and hospitality can witness such brutality.

Believing that it would be of interest to obtain information as to the success of the planting in Lake Chapala, the Mexican consul in San Francisco was appealed to, with the result that the following interesting reports were received:

(TRANSLATION.)

Government of the Free and Sovereign State of Jalisco.
Section Fourth, No. 16582.

To the Consul General of Mexico,
519 California Street, San Francisco, California.

Referring to your attentive communication dated October 31st last, by which you request information as to the success attained in acclimatizing in the Lake of Chapala the fish called black bass (lobina), I beg to inform you that I have, on my part, requested this information from the city mayors of the lake cities and their replies were the following:

Chapala Mayor's report:

"I have the honor to refer to your respectable communication issued by Section 4th dated on the 12th inst. and in reply to it I beg to inform you that in the Chapala Lake can be found the fish called BLACK BASS, in short number being more abundant toward la Cienega, La Palma and Jamau as I have been informed; in this place are caught very few of them due to the fact the fish named Carp (CARPA) fight them to death destroying either the fish itself or their spawn, being more destructive in the latter case which danger has not been possible to avoid on account of the latter named fish Carp is a courageous fighter against the other less warlike fishes as is the case with the WHITE FISH, BLACK BASS and other named CHARAL. This is, in my opinion, the cause that the fish in question is not more abundant, although I believe in its acclimatizing."

Jocotepec Mayor's reported on the 20th inst:

"Informed to my satisfaction from the most prominent fishers of the Lake of Chapala, in this region, I have the honor to say in response to your communication No. 9508, issued by Section 4th on the 12th instant that: on the shores of said Lake within the limits of this Municipality, they have not fished the BLACK BASS (Lobina) or Delicious fish that is known but it is believed it can be found in Jamay or in the emptying of the Rio Grande into the Lake."

Jamay Mayor's reported on the 29th inst. as follows:

"In reply to your communication No. 9509, issued by Section 4th on the 12th inst. I state that after the investigations made in order to find if the fish known by the name of LOBINA the fishermen of this place only informed me on the fishes they fish in this part of the Lake, viz: BAGRE in very short amount, the WHITE FISH very scarcely and that the fish named Carp is the more abundant."

Tuxcueca Mayor on the 20th inst reported:

"I beg to inform that respectable Government that in the region of Lake Chapala within the jurisdiction of this Municipality the fish known by the name of LOBINA has not been found and that I ignore whether this fish is to be found in any of the *other Municipalities* around the lake."

Tizapan Mayor, under the same date as the above, report as follows:

"I have the honor to inform you in accordance with the inquire contained in the communication of that Superiority under the number 15006, issued by Section 4th dated on the 15th inst. that on information collected from the fishermen within the jurisdiction of this Municipality is not known the fish named LOBINA mentioned in your said communication in any of the places where the fisheries are established."

Ocotlan Mayor under same date report:

"Relative to your attentive note No. 9510, issued by Section 4th dated the 12th of November ultimo in which you transcribe me the communication dated on the 21st of October last from the Consul General of Mexico in San Francisco, California, for the knowledge of the Governor of the State I have the honor to inform you that the fish known by the name BLACK BASS (Lobina), delicious fish, to which the preinserted note makes reference and known in all these places with the name of (LIZA) has been propagated relatively little in the Lake of Chapala and in a nearby place to El Fuerte, within the jurisdiction of this Municipality and in which place about 15 fifteen years ago approximately this fish was placed for its propagation but we have information that in the town of Poncitlan it is found frequently in the dam and in the river passing by that place."

Please to accept my attentive and distinguished consideration.

THE CONSTITUTIONAL GOVERNOR OF THE STATE.

Guadalajara, Jalisco, December 23, 1921.

The stated fact that black bass have not multiplied to any extent in the lake for the principal reason that carp have destroyed the spawn, is hardly plausible, for unless the Mexican species of carp is as aggressive and courageous as the Mexican bull, this is not the reason for the apparent lack of increase. Both the male and female black bass remain with the eggs in the nest until they are hatched, and both remain with the young fry afterwards. There is no American fish bold enough to attack a black bass or its eggs. In lakes where bass only abound, necessity compels the adult fish to devour its young, but Chapala has an ideal food in the whitefish. We have made many plantings of bass and have never seen a body of water having more of the requirements necessary to the successful introduction of these fish than Lake Chapala.

The black bass are the most difficult fish to catch with a net. They require certain lures to take them, such as live minnows, spinners, etc. In a body of water the size of Lake Chapala, containing all the natural feed, these fish are doubtless difficult to capture. In spite of the foregoing report, we feel positive they are present in large numbers and can be taken by those who know how.

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All material for publication should be sent to H. C. Bryant, Museum of Vertebrate Zoology, Berkeley, Cal.

APRIL 22, 1922.

"Of all sports, commend me to angling; it is the wisest, virtuousest, best."—*Thomas Hood.*

NEW EXECUTIVE OFFICER.

On March 14 Mr. Charles A. Vogelsang, who has been executive officer since 1920, resigned to accept another, more remunerative, position. Mr. George Neale, who has been in charge of the *Sacramento* district office since 1911, was *appointed* to succeed Mr. Vogelsang. Mr. Neale comes to his position as one intimately acquainted with the fish and game of this state and the problems connected with its conservation. Every employee of the commission is extremely well pleased with the appointment, for they know that from the standpoint of knowledge, experience and personality, Mr. Neale is well equipped for his future work. It is fortunate, also, that the new position comes as a promotional appointment under civil service.

George Neale, executive officer.

George Neale came to California when he was sixteen years of age, spending two years in San Francisco and then settling in Sacramento, where he entered the market produce business. Due to his interest in fish and game he was appointed game warden of Sacramento County in January, 1901, and two months later was appointed a deputy state fish and game commissioner. He proved himself a capable warden, cleaning up a particularly bad situation due to the laxity of enforcing the laws. On August 8, 1911, he was placed in charge of the Sacramento district office, which he has efficiently managed up to the present time.

Mr. Neale is an ardent angler and hunter and a true conservationist, and sportsmen and conservationists alike may look forward to an efficient administration of the fish and game resources of the state.

A HATCHERY NUMBER.

Perhaps the most outstanding achievements of the California Fish and Game Commission have been the successful introduction of numerous food and game fishes and the artificial propagation of trout and salmon for use in stocking barren streams and lakes and restocking depleted waters. Everybody knows from the local papers that sometime during the summer and fall the fish car makes an annual visit to some town close by and that thousands of trout fry are carried to nearby streams by interested sportsmen, but of methods and actual output from the hatcheries the average citizen knows little. How many hatcheries are there? What is the annual output? How are trout fry planted? These and many more questions are answered in this "Hatchery Number."

The Fish and Game Commission boasts of having retained the continuous services of a skilled fishculturist for thirty-nine years. Mr. Wm. H. Shebley, in charge of fishculture, whose picture is shown above, has the distinction of being the commission's oldest employee and of having been trained under such pioneer fish-

culturists as Livingston Stone and J. G. Woodbury; Mr. Shebley, in consequence, knows California conditions and knows how to raise fish. The hatchery department has many employees who have

William H. Shebley, in charge fishculture.

"grown up" with the work. One of the employees, Mr. E. W. Hunt, field superintendent, has served the commission for thirty-five years; two others have served more than twenty-five years; four, more than fifteen years, and six for more than ten years. The efficiency of the department can be partly traced to the fact that the men engaged in fishcultural work are all experienced men.

INCREASING DEMAND FOR TROUT FRY EXHAUSTS HATCHERY RESOURCES.

Easy access to the streams and lakes afforded by the improved highways and the increasing use of automobiles, and the added thousands of people who are availing themselves of the opportunity to fish, are factors that have combined to make an ever-increasing demand on our hatcheries for fish for restocking. Each season sees a marked increase in the number of people who seek recreation in our mountainous districts, and the consequent drain on the trout in our lakes and streams *has been very great, particularly during the past five years.* To meet the need, the department of fishculture has exhausted its resources. Every available dollar has been devoted to fishcultural work, and yet the demand increases.

Only a partial solution is possible as a result of the reduction of the bag limit from fifty to twenty-five. It may be that a shorter fishing season will have to follow in order that depleted streams and lakes may be afforded a chance to recover their former condition.

Every state in the Union where there is game fish to be found is confronted by the same problem. In most cases the condition is being met by an increased angling license to provide more funds for enlarging the output of the hatcheries. This is the remaining remedial measure left to California.

FREE FISHING FOR ALL.

For fifty years the Fish and Game Commission has been stocking the lakes and streams of the state with trout. That any of these stocked lakes and streams should become private property, with consequent restriction of fishing, would be an injustice. Several years ago the actions of certain riparian owners caused the commission to advocate the passage of a law providing that boards of supervisors could, if necessary, condemn a right of way along a stream for the use of fishermen. This law was passed. In recent years there have been many attempts by private individuals to close public fishing on certain lakes and sell fishing privileges for as much as $10 a day. The one thing that has saved these lakes from becoming private preserves has been the fact that the state has annually stocked them, and consequently the fish do not belong to the riparian owners. Likewise, the importation of trout fry from other states has been discouraged, in order to prevent like developments. It seems reasonable that those who would make private gain from fish should utilize artificially constructed ponds, rather than publicly stocked waters. The commission positively refuses to stock with trout fry any waters of the state which are not previously declared in writing by the owners to be open to the general public for fishing purposes.

The Fish and Game Commission believes in championing the people's rights. This is substantiated by the attitude on proposals for making private fish preserves out of streams and lakes stocked by the state and by the action taken during the last legislature, when the attempt was made to place fish and game administration under a subsidiary division of the Department of Agriculture.

CONDITIONS SHOULD DETERMINE SPECIES OF TROUT PLANTED.

Many of the applicants for trout fry specify a preference for rainbow. There is no doubt but that the rainbow is the gamiest of the trout, and usually superior for food, also; but it must be remembered that some of the introduced species do better than our native trout in some localities. The eastern brook trout, although a failure in coast streams, thrives in the slow-moving, meandering stream of a mountain meadow, whereas the rainbow is at his best in the rushing, boulder-strewn stream of the granite-walled canyons. Furthermore, it has been found that the brown trout thrives in certain streams where attempts to furnish good fishing by planting rainbow failed. The Loch Leven makes a splendid stream and lake fish and grows to large size. The steelhead, which furnishes a better supply of eggs than the rainbow, makes a suitable substitute for the rainbow in most situations. Were a sufficient and economical supply of rainbow eggs available, the commission would be pleased to supply the constant demand for this species, but the securing of a larger supply than is now obtained is difficult and expensive as well. The fishcultural department is in a position to know what species will thrive best in the different localities, and it attempts to allocate the fry accordingly.

THE PLANTING OF FRY.

The Fish and Game Commission is constantly receiving requests from all parts of the state for assistance and cooperation in planting trout and other fry in the waters of the state. It has been and is becoming more and more impossible for the commission to bear the additional expense of planting fry, as increasing demands necessitate the use of all funds available for the propagation and rearing of the fry to the planting stage. The expense of distribution has for many years been cheerfully borne by anglers' associations and individuals most interested. That this method of planting continue seems the more reasonable, because of the increased cost of transportation and because of the personal interest developed. During the war all free transportation of fish and employees engaged in fish planting was cancelled by the railroads, and the former privileges have never been restored. The commission now pays full transportation for the two fish cars and employees, and the annual bill amounts to thousands of dollars. *From the standpoint* of conservation the present method is desirable, for the reason that individuals or associations cooperate with the commission in planting fish and assume an interest in the plant made, and good publicity results from the cooperation. Apparently, neither anglers' associations nor individuals have found their share of the work a burden.

ELECTRIC FISH SCREEN.

Several articles have appeared in recent periodicals relative to the perfection of an effective screen utilizing an electric current for use in irrigation ditches. These articles are altogether too optimistic, in the light of investigations made by the California Fish and Game Commission. On several different occasions the apparatus has been given a thorough test and found unsatisfactory. Young fish, placed in a ditch for experimental purposes, readily ran between the electrodes when the current was not too strong, and were quickly killed by the current as soon as a certain voltage was obtained. Considerable time and money have been expended by the commission in an endeavor to test and see whether electricity could be used advantageously as a means of screening fish from irrigation ditches. But up to the present time no one has satisfactorily demonstrated that this principle is practical when trout and salmon are to be prevented from passing into large ditches or canals. Further experiments will be made this coming season on an improved method of using the electrodes.

MANY SPECIES OF TROUT SUCCESSFULLY REARED.

The species of trout which have been successfully reared at state hatcheries follow:

NATIVE.

McCloud River rainbow	*Salmo shasta*
Rainbow	*Salmo irideus*
Cut-throat	*Salmo clarkii*
Steelhead	*Salmo gairdneri*
Black-spotted	*Salmo henshawi*
Large lake	*Salmo tahoensis*
Golden	*Salmo roosevelti*

INTRODUCED.

Eastern brook	*Salvelinus fontinalis*
German brown	*Salmo fario*
Loch Leven	*Salmo trutta levenensis*
Mackinaw	*Cristovomer namaycush*
Landlocked salmon	*Salmo salar sebago*
Grayling	*Thymallus montanus*

Experimental hatching of several other food fishes has been undertaken at vari-

ous times. Included were the whitefish, striped bass, shad, muskallunge and Japanese ayu.

FISH TRANSPORTATION.

At first, transportation of fish to the stream was accomplished with horse and wagon, or by direct express shipments or in baggage cars. At the 1909 session of the legislature $7500 was appropriated for a fish car and equipment. The car, 60 feet long, was built in the shops of the Southern Pacific Company at Sacramento and is still in use. It is fitted up with an engine-room in which is located a boiler for generating steam to run two Westinghouse air-pumps, used for forcing a circulation of air through a series of pipes and tubes into the 125 cans that the car is equipped to carry; also a refrigerator, tanks for carrying a supply of fresh water, berths for the attendants, a culinary department, an office for the superintendent of the car, besides lockers for the tools and equipment required in carrying the fish. This car has enabled the commission to carry thousands of fish in perfect condition all over the state, at a saving in the cost of transportation amounting to hundreds of dollars each season. Formerly it required two men to care for 12 or 15 cans; in the special car four men can care for a load of from 100 to 125 cans, carrying from 200,000 to 400,000 fish. Since the car has been in operation, three times as many fish as before have been distributed during the same period of time. Furthermore, the fish carry better and are delivered in better condition. A second fish car was put in operation in 1915.

In recent years the motor truck has played an important part in transportation. The Mount Whitney Hatchery is equipped with two large trucks. There is a one-and-a-half ton truck in use at the Mount Shasta Hatchery; the distribution of fish from the Feather River Hatchery is handled with a two-ton truck and each of the other important hatcheries has a Ford truck as part of the equipment.

From the nearest railway station the fish are carried to the mountain stream either by truck or by pack train. Special pack-cans are utilized with animals, and the fish stand long journeys without injury.

TROUT FOOD INTRODUCED.

It seems reasonable to believe that an increased food supply for trout in certain streams might increase the supply and better the fishing. The commission has consequently experimented in the transplantation of certain insects and crustaceans notable as food for trout. As early as 1897 crawfish and salmon flies were introduced into the Truckee basin. In more recent years salmon flies have been introduced and now thrive along many streams in the Tahoe region.

IN MEMORIAM.

George McCloud departed this life October 19, 1921. He was born near Gazelle, Siskiyou County, June 24, 1863. The son of Ross A. McCloud, one of the pioneers of Siskiyou County, who at one time was county surveyor, George McCloud spent his childhood at Upper Soda Springs and at Yreka.

He was educated in the common schools of the county and in Ashland Academy. After leaving school he was employed on the survey of the Southern Pacific Railroad under Chief Engineer William Hood, when that road was being surveyed and built through the Sacramento Canyon and over the Siskiyou Mountains.

In 1886 he came into possession of a half interest in the Upper Soda Springs resort, and with his sister, Mrs. Elda Massen, operated this popular resort for a number of years. During this period he established a resort on McCloud River, that was named after his father. The best information that the writer can obtain regarding the origin of the name of McCloud River, is that it was named after Mr. McCloud's father, Ross A. McCloud. This statement has been disputed by some, who claim that the river was named after a man named McLeod, who was in the employ of the Hudsons Bay Company as a trapper, but there is not any doubt in the minds of the first settlers that the McCloud River was named after Ross A. McCloud, who came to Siskiyou County in the early fifties and prospected on the river that was given his name by early settlers. George McCloud sold his McCloud River property in 1890 to Clarence Waterhouse, who employed him as his fiduciary agent in charge of his property on the McCloud River, as well as on a mining venture in Alaska.

George McCloud was a thorough sportsman and enjoyed the esteem of the best sportsmen in California. His knowledge of wild life, particularly the fishes of Northern California, gave him an enviable reputation, and his services were often sought by those who desired to enjoy an outing where good fishing could be had.

In 1911 he entered the employ of the California Fish and Game Commission,

His knowledge of the trout and salmon was of great value to him in his new position, and he made rapid progress in his work. He was employed as fishculturist in charge of an egg-collecting station, and superintendent of one of the commission's distribution cars, until his illness early in the summer of 1921 caused him to retire.

Mr. McCloud's death is deplored by a host of friends. He was an honest, upright and concientious man. In his passing the Fish and Game Commission lost an efficient and dependable employee.

There survive to mourn his loss his wife, Mrs. Mary McCloud; two sons, Ross A. McCloud, who succeeded his father as superintendent of distribution car No. 2, and George McCloud Jr., superintendent of Mount Whitney Hatchery; two daughters, Mrs. Carrie Hickman and Mrs. Ruth Wheeler, and a sister, Mrs. Elda Massen.

George McCloud, pioneer of Siskiyou County, for many years a trusted employee of the Fish and Game Commission.

RAINBOW TROUT THRIVE IN HAWAIIAN ISLANDS.

Within the past few years the United States Bureau of Fisheries has sent two lots of rainbow trout eggs to the Hawaiian Islands: 50,000 in the spring of 1919 and 25,000 in the spring of 1920. The executive officer of the Fish and Game Commission of the Territory of Hawaii, under date of December 20, 1921, reported as follows: "In the streams visited on Kauai which had been stocked, dozens of rainbow trout were seen in every pool. I have never seen more fish in virgin streams in the Cascade Mountains. The fish all have the appearance of being very fat and averaged about 10 inches." The bureau plans to send a further consignment of rainbow eggs to the islands this spring.

MANY LIONS SECURED IN GAME REFUGES.

Since the beginning of operations by the state lion hunter, 47 mountain lions have been killed in and around game refuges and 20 others in and around national parks. Eight lions have been killed in Fish and Game District 2A, five in Fish and Game District 3C, one in

Fish and Game District 3B, twelve in Fish and Game District 1E, and twenty-one in Fish and Game District 1I, on the three different trips into this refuge. Eight lions have been killed in and around Sequoia National Park and twelve in and around Yosemite.

COMMISSION FEEDS DEER AND QUAIL.

During February of this year the extreme cold weather caused much suffering among the wild birds and animals, especially among the quail and deer, in the higher altitudes of the state. Realizing the need for action in the matter, President Newbert of the Fish and Game Commission circulated through the newspapers the following letter:

"This is the time that tells the tale whether a man is just a meat hunter or a real red-blooded sportsman. It may be that many wild birds and animals are isolated in areas where it is impossible for our wardens to find them, owing to the deep snow. Nature teaches all wild life when in need to seek man and civilization.

"Therefore, residents of farms or towns are in a position to render aid by feeding these wild birds and animals. Our commission is more than willing to purchase feed to tide over these storms, and will authorize the expenditure of funds by our wardens.

"We ask all lovers of wild life to feed, temporarily at least, birds and animals until such time as our local deputy or district office may be notified."

The enthusiastic response to this letter, not only from the deputies and forest rangers but from many of the residents who fed numbers of birds and animals gratis, was very gratifying. In Plumas County about 150 head of deer were saved from starvation. In Siskiyou County several large flocks of quail were fed, one flock numbering 250. Fortunately no great loss has been reported, though the quail above the 2000-foot altitude were without feed for four days.

In Lassen County, deputies fed large numbers of quail and pheasants every day, as well as deer and antelope. The grain and hay used was furnished gratis by the people of the section. In Grass Valley the estimated number of quail cared for was 2500, and the number of deer about 400. Twelve hundred pounds of hay and 237 pounds of grain were fed at Indian Valley alone, the work requiring the assistance of several men, with teams, pack horses and mules.

REDDING DAM DISPUTE SETTLED.

The controversy regarding the installation of a fish ladder on the dam of the Anderson-Cottonwood Irrigation District at Redding has at last been settled. An injunction suit was brought by the commission against the irrigation district, and the case came up for trial on January 30, 1922, before Judge Herzniger of Redding.

The commission fully demonstrated that a suitable fishway had not been erected and that as a direct result thousands of salmon have found it impossible to reach their spawning grounds. But in order not to be too implacable in its attitude toward the irrigation district, which is already in financial troubles, the commission finally, on the fourth day of the trial, agreed to a settlement. The following agreement was signed by officials of the Anderson-Cottonwood Irrigation District and by the executive officer of the California Fish and Game Commission:

"The board of directors of the Anderson-Cottonwood Irrigation District and the people of the State of California, represented by the Board of State Fish and Game Commissioners, will cooperate, with and by the advice of the engineers of said district and the engineer of the State Fish and Game Commission, to use present facilities offered by the dam of said district for the purpose of passing salmon over said dam, to the end that the flow of water in the canal of said district shall not be impaired and the migration of salmon shall not be obstructed, and to that end the following recommendation is made:

1. Insert flash boards in the present fishway to check flow of water through the 12-foot space and from a pool below.

2. If this proves inadequate, insert flash board in vertical plane to perfect fishway.

3. If this proves inadequate, sink a timber box, 12 feet square, above the dam at the fishway to form an additional pool.

If it is found that said plan does not operate as a fishway for the free passage of salmon, then, and in that event, said district agrees to make such improvements on said dam as will adequately facilitate the passage of salmon over said dam, this being the intent and purpose of this agreement, and if any additional facilities for the passing of salmon over said dam are found necessary, should the proposed scheme prove inadequate for passing salmon over said dam, any further improvements made necessary shall be made with due regard to economy as well as to the other purposes to be accomplished herein.

(Signed) Anderson-Cottonwood Irrigation District; David Nelson, director; Charles H. Spann, director; W. F. Smith,

director; Andrew Jessen, director; California Fish and Game Commission, Charles A. Vogelsang, chief executive officer."

As a result of the above agreement, a dismissal of the case was ordered by the superior court. Thus was ended one of the bitterest fights having to do with the conservation of salmon and the enforcement of the law relating to fishways.

MOUNT DOME ANTELOPE HERD.

The largest herd of antelope remaining in California makes its home at the south end of lower Klamath Lake, near Mount Dome. A recent census has shown that about 100 of these animals are to be found in this region. Because of the past hard winter these antelope were in need of additional food. The big game committee of the California Academy of Sciences, headed by Mr. M. Hall McAllister, became interested and furnished funds for the winter feeding of the herd. The accompanying photograph (Fig. 57) shows forty of the eighty-seven animals which came in to feed. The California Fish and Game Commission, the United States Forest Service, the California Academy of Sciences and other organizations are cooperating to give these antelope a maximum of protection. Several men have been deputized to watch for poachers and to see that the animals are properly cared for, and a move is now on foot to have a large area set aside as a permanent refuge for these antelope.

COLD WEATHER KILLS PISMO CLAMS.

Subtropical fruits and vegetables are not the only things which may be killed or injured by cold weather in California. It has been reported to the State Fish and Game Commission by its deputy H. D. Becker that the recent cold snap has resulted in the killing of great numbers of Pismo clams, which in this instance may be compared with subtropical fruit, for they are a southern form and in San Luis Obispo County, where freezing was most noticeable, are near the northern limit of their range. Some clams, like the eastern soft shell which remains stationary in its hole in the mud, may be frozen almost solid and be no worse for the experience after thawing out, but it is not so with the Pismo clam.

Fig. 57. Antelope on the proposed Mount Dome Antelope Refuge. Photograph taken January 15, 1922, by J. O. Miller. About 40 antelope show in the picture.

Through investigations made for the Fish and Game Commission by Professor F. W. Weymouth of Stanford University, much has been learned of the growth and habits of this interesting and most important of California's clams. The young Pismo clams spend the first three years of their existence above the low-tide line, on gently sloping, sandy beaches. They are very active creatures and can bury themselves rapidly in the sand by means of their tongue-like "foot." And it is necessary that they be active, for the sand is continually moving in the surf, and in the wash of the waves during the flow of the tides up and down the beach they

would be washed out and cast high on the beach if they did not dig rapidly.

During the recent cold spell these clams of tender age, being the young crop of the last three years and with shells not exceeding three inches in diameter, were so chilled or frozen during the few hours they were left exposed in the wet sand while the tide was out that they were unable to dig in with the flow of the tide, and were ignominiously cast high on the beach, where, with muscles too near frozen to keep their shells from gaping, they fell easy prey to the gulls and pelicans, which came from far and wide to the feast.

The damage to the young crop of clams has been very great. But, serious as is this loss, it is not nearly so serious as the destruction to these immature clams caused by summer visitors to our beaches digging them for food and sport in violation of the law, which prohibits their capture until they have developed shells 4½ inches in diameter. It is unfortunate that the best beaches for Pismo clams are also our best pleasure beaches, where the people congregate in great numbers each summer. It is natural to dig in the sand, and if there is a prize to dig for, even if it be a very small clam, it seems to add fascination, and the chance of being caught by a game warden appears to lend excitement to the sport. Only once in the memory of the oldest inhabitant has extreme weather killed the young clams, but destruction of the young crop always exposed to thoughtless pleasure seekers takes place every year, and is far more serious.

The Fish and Game Commission has been warned by Professor Weymouth that destruction to the young crop of clams in violation of the law is more serious by far than the recent destruction by cold weather, or even the operations of professional clam diggers, at whom the local clam conservationists have been pointing their fingers. The matter is so serious that even the prohibiting of professional digging and the sale of clams may not save the Pismo clam from becoming extinct in California, unless the public learns the importance of protecting the undersized clams. Legal-sized clams can be found at extreme low tide, or, if one wishes really exciting sport, let him go into the surf after them with a clamming fork.

FISHERIES CONFERENCE MEETS AT SAN PEDRO.

In January the scientific staff of the California State Fisheries Laboratory at *San Pedro held a conference* to discuss the program which is designed to properly care for the fisheries of the State of California, particularly the great sardine fishery which has arisen within the last five years and which in 1919 produced 154,000,000 pounds of food fish.

So recent has been the origin of this great fishery that nothing is yet known about the permanence of its supply of fish. Fishes of the group to which the sardine belong show great fluctuations in abundance, at times being so scarce as to greatly limit the fishery for them, at others being in enormous abundance. The scientists of the State Fisheries Laboratory have planned their work to provide information concerning the possibility of such great and disastrous changes, which will be studied according to the most recent methods developed in Europe by the International Council for the Investigation of the Sea, and by Norway.

The program devised will also bring out the possibilities of depleting the fisheries by imposing too great a strain. It is not yet known whether the fisheries on the Pacific Coast are able to stand such strains as have been placed upon the Atlantic species of fish, but it is surmised that they can not. The sardine, as do other fishes, depends upon the food produced by waters near the shore, where certain natural elements necessary to the growth of their food are present. Along our coast this coastal water supply is decidedly limited compared to that found along the coasts of northern Europe, where the greatest fisheries have been carried on. It will be necessary, therefore, for the California Fish and Game Commission to exercise special vigilance to see that the supply is not exhausted by reckless use, such as the use of sardines for fertilizer in unlimited quantities. The observation of the supply is a matter for careful scientific observation by biologists, along lines similar to those indicated by the men in session at the laboratory.

But it has been necessary for the commission to do more than provide such a program of work, for it has become obvious that men specially trained for its execution are necessary. Since such men are not obtainable at the universities, the State Fisheries Laboratory has undertaken the training of students, who are later expected to finish college, where they are granted sufficient work and payment therefor to constitute a scholarship. The conference dealt with these matters, as well as the program of work.

This conference was held in the splendid new building recently completed for the scientific workers at San Pedro.

MARKET HUNTERS FIND WATCHFUL WARDENS.

The sale of ducks is now largely a thing of the past. Where the San Francisco markets formerly had 300,000 ducks, the illegal sale at present must be but a few hundred, or at most a few thousand birds. Of course, in spite of the federal law prohibiting the sale of ducks, the incentive of the dollar drives a number of men to continue each winter their former trade of market hunting. Automobiles and good roads make it possible for the duck bootlegger to continue to operate. But quick convictions and heavy fines have been meted out the past season, and the man who hunts for the market has to turn outlaw and smuggler.

The accompanying picture (Fig. 58) shows the destruction due to this type of hunting. Deputies of the commission heard night shooting near Willows on December 14, 1921, and investigated. The hunters ran, leaving a hat and "long gun" (an automatic capable of firing ten shots) and hundreds of ducks on the ground. After the birds had been collected, the photograph was taken.

Information withheld by residents of the duck country sometimes makes it difficult to make arrests. Deputies spend night after night in the cold, wet marshes, doing their utmost to stop market hunting, and yet those who could be most helpful in furnishing information refuse *to aid. Proper* information is often the *most important* part of gaining an arrest *and conviction.*

FAULT FOUND WITH THE PUBLIC SHOOTING GROUNDS BILL.

The New-Anthony bill providing for a federal license to hunt migratory birds and for the establishment of public shooting grounds and game refuges, which has been widely endorsed by sportsmen's organizations and game commissions, was not all that it was made to appear to be in the publicity given it. By a provision almost hidden in the text there is unwarranted encroachment by the federal government on the rights of states. Section 13 provides for complete control of every "fish, wild animal, or wild bird," whether it be resident or migratory. Judging by court decisions, this is unconstitutional. Furthermore, the bill provides for administration by a commission composed of the Secretary of Agriculture as chairman, the Attorney General, the Postmaster General and two members from each house in Congress. How are the sportsmen represented on such a committee? Worse, the commission is purely political and has the power to spend millions of the sportsmen's money. Any law of this kind should be administered by a commission made up of conservation experts.

It was the fish and game commissioners of the Western states that discovered the flaws in the bill and made the first important protest. A convention was held at Salt Lake City and the following resolutions were passed:

FIG. 58. Ducks seized near Willows on December 14, 1921, after night-shooters had abandoned their kill at the approach of Fish and Game Wardens.

A RESOLUTION

Adopted by the Western Association of State Game Commissioners January 17, 1922.

The several commissioners and game wardens of the game and fish departments of the states of Arizona, Colorado, Montana, New Mexico, Oregon, Utah and Wyoming, in conference assembled at Salt Lake City, Utah, this seventeenth day of January, 1922, having carefully considered United States Senate Bill No. 1452, entitled "The Federal Public Shooting Ground and Game Refuge Act," do unanimously adopt the following resolutions:

WHEREAS, We appreciate the need for the establishment of public shooting grounds and game refuges in various parts of the United States, for the benefit of the public at large and for the protection of migratory birds; and

WHEREAS, We, through our several game and fish departments in the states which we represent, have given our full support and cooperation to the efforts of the federal government to successfully administer the present federal migratory bird laws and regulations; and

WHEREAS, We approve of the purpose and aims of the federal government as evidenced by the present migratory bird laws and are in favor of such additional legislation as may further such purpose; and

WHEREAS, On the other hand, we are not unmindful of the inherent sovereignty of the several states as recognized in the decision of the Supreme Court of the United States in its determination that the game and fish within the confines of each state are the property of such state and, therefore, under the jurisdiction and control of state authority; and

WHEREAS, We disapprove of the centralization of control in the federal government, of the game birds, animals and fishes which find their range within the confines of any state; and

WHEREAS, The purport of said Senate Bill No. 1452 is not, in our opinion, as indicated in its title, but, on the contrary, is designed to, and will result in, an unwarranted encroachment by the federal government upon the rights of the various states in the protection of their fish and game, and in the administration of their fish and game laws; now, therefore, be it

Resolved, That we protest against the enactment into law of United States Senate Bill No. 1452 for the reasons as set forth in the foregoing preambles and more specifically because:

1. Said Senate bill, although in its title "providing for establishing shooting grounds for the public; for establishing game refuges and breeding grounds; for protecting migratory birds and requiring a federal license to hunt them," nevertheless, in the body thereof, purports to give authority in nowise indicated in the title, and delegates power to the Department of Agriculture and a committee consisting of the Secretary of Agriculture, the Attorney General, the Postmaster General, two members of the Senate and two members of the House of Representatives, giving said commission complete legislative powers to make rules and regulations which will *have the force of laws governing and controlling*, not only the migratory birds and the game animals, but also the fishes that may be found in their natural state or introduced into any of the lands or waters upon any game preserve secured under said act, either by gift, lease or purchase.

2. We do not approve of creating a federal organization of game wardens which, in the enforcement of said act, will largely duplicate the work of the state organizations for the protection of fish and game, thereby increasing the operating expenses necessary to the enforcement of the law, and tending to create conflicting authority between state and federal game wardens and to disrupt the harmony and unity of purpose now existing between the state and federal departments.

3. We object to the federal government assessing a license fee against citizens of a state for the privilege of hunting and fishing within the confines of his own state.

AND WHEREAS, We believe that the enforcement of the migratory bird law is of sufficient importance to justify a direct appropriation from Congress for that purpose; be it further

Resolved, That we favor a direct appropriation from Congress for the purpose of enforcing the Migratory Bird Treaty Act and the establishment of public shooting grounds and game refuges under the direction of the Biological Survey.

It has been determined to express the foregoing ideas in resolution form for the purpose of conveying to the Congress of the United States a concrete expression by the fish and game officials of the above named states who are primarily interested in legislation, be it state or federal, which will be most suitably designed to accomplish the protection and increase of the fish and game of the country and to avoid submerging a laudable common purpose, in disputes and conflicts (intensified possibly by a sense of unjust assumption of federal control) between officials and employees of departments of government with overlapping coordinate authority.

J. W. TINGEY, Secretary. D. H. MADSEN, President.

The original bill thus exposed should have no chance of passing, but strange things happen, and if sportsmen and conservationists remain apathetic, states will be robbed of their rights and sportsmen's license money exploited by a political commission. The California Fish and Game Commission has now refused to support the bill unless it is suitably amended, and California representatives in Congress have been so informed.

DEER HUNTERS SHOOT CATTLE.

In our January issue a long list of hunting accidents furnished evidence that many hunters are careless when in the field and fail to "look before they shoot." Now comes additional evidence of like carelessness in a report of the United States Forest Service, which states that

on eight of the national forests of this state sixty-four cattle and three horses met death from hunters' bullets during the last open season. And this killing of animals is but one of the just complaints of the cattleman. Some hunters, neglectful of others' interests, break down fences and leave gates open. Furthermore, in late summer, campers often usurp the only watering place for miles around and continually drive the cattle away, to finally die for lack of water. Unless hunters take some steps to correct these evils themselves, it is certain that the men financially concerned will be instrumental in further curtailing the hunter, and the careful will be made to suffer with the careless.

EDUCATIONAL WORK IN YOSEMITE TO CONTINUE.

At the request of the National Park Service, the Fish and Game Commission will again cooperate in educational work in the Yosemite National Park this coming summer. As in past years, the incidental expenses and the expense of assistants will be assumed by the National Park Service. Last year over 31,000 persons received instructions through the medium of lectures, and over 2000 persons were taken afield and given first-hand information regarding wild life.

The California Nature Study League, which has been greatly interested in the project, recently sent the following letter to President Newbert:

MR. FRANK NEWBERT,
President California Fish and Game Commission,
Sacramento, California.

MY DEAR MR. NEWBERT:

On behalf of the California Nature Study League, may I thank you for the Fish and Game Commission's continued conduct of the educational work at Yosemite National Park? There is probably no money expended by the State of California that will eventually bring bigger dividends to the taxpayers than such educational work.

The last time I was leaving Yosemite I happened to meet on the train a group of people from San Mateo County. One of the children, a girl of about eleven, had been tested in the mental tests at Stanford University. She ranked so high that the professor declared she was about one in a million. In other words, there were only about 110 people in the United States, adults and children, as bright as this girl. In other words, she will be a genius of the tomorrow. She had had training along other lines, as literature and art, but her first stimulus to scientific education was through the work of Dr. Bryant of your staff.

Just what may come of this you and I will probably never know. We will probably both be old men if we even live to see the fruiting of that intellect. Does it not show dramatically, however, the tremendous possibilities of the wild-life conservation work which your commission is doing?

Sincerely,
(Signed) C. M. GOETHE, President.
California Nature Study League.

STANFORD PLANS ANIMAL REFUGE.

If the plans of the Zoological Club at Stanford University are successful the 800 acres comprising the Stanford Farm will become a state game refuge. The Zoological Club has offered to furnish the labor necessary for making and posting signs and to render all possible aid in detecting and reporting violators of the refuge. Illegal hunting and wanton killing by people from off the campus has stimulated this move to carefully conserve all the animal life of the university holdings.

BIG GAME IN SWEDEN.

Moose are to be found in many of the central and northern provinces of Sweden and are being conserved and protected in spite of open hunting grounds and the absence of artificial game regulations which are so common in other European countries. The open season is two weeks in September, and each permittee is allowed to take one cow and one bull. There is no general license system; the hunter may procure a license from the state for hunting on state lands, or, if hunting on private lands, a permit may sometimes be obtained from the owner; in either case the cost of the license is much greater than the cost of the American license.

The following table shows the number of moose killed in different parts of Sweden during the year 1919, as reported by forest supervisors and rangers of the Swedish Forest Service:

Number Killed During the Two Weeks Open Season.

Bulls	791
Cows	580
Calves	7
Sex not given	31
Total	1509

Number Killed During Closed Season.

----------	22	
----------	12	
----------	4	
t given----------	80	
tal ----------——		118
illed during year----------		1627

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eneral, the reports show that the are decreasing, due to excessive hunting during the years of crisis. A closed season for several years is contemplated.—G. W. HULT, San Francisco, California.

9. Rainbow trout caught on San River and *photographed* by A. A.

A PHOTOGRAPH OF A RAINBOW TROUT.

Since clear, detailed photographs of fish are often difficult to obtain, we are publishing herewith a successful picture of a rainbow trout secured by Mr. A. A. Rohde of Fresno, California, taken near Bass Lake, Madera County, on the San Joaquin River (Fig. 59). Mr. Rohde took this picture with the fish two feet from the camera, using a Ray color filter over the lens and a 5 by 7 plate. The trout weighed 3 pounds and was 8 inches in length.

DANGER TO FISHERIES FROM OIL AND TAR POLLUTION OF WATERS.

In the report of the United States Commissioner of Fisheries for 1921, Mr. J. S. Gutsell discusses at some length the danger to fisheries from oil and tar pollution of waters. He points out that three main sources of oil and tar pollution have been found: Road washings, carrying great quantities of lubricating oil; gas houses and oil refineries; tankers, oil burners and oil-engined shipping. Tars, tar oils and crude distillery products are found generally to be highly poisonous, whether in weak or great dilution. Some oils have been found to emulsify to a sufficient degree, with continued agitation, to coat the gills of fish and so produce death by suffocation. An oil film, through prevention or checking of aeration, is dangerous, particularly in busy harbors. The deleterious effect on spawning, by rendering spawning grounds unfit or inaccessible, is a grave danger arising from the pollution of harbors and streams. Another serious danger is found to lie in the possible effects on the diminution of the food supply. Through whatever means, it is an observed fact, according to Weigelt, that in Germany fish have completely disappeared from pools and ponds following the discharge of mineral oils into the water. In the sea a great danger is suggested by the fact that the eggs of sea fishes are typically floating, and that oil-burning and oil-engined shipping is greatly increasing.

Remedial measures may (now or in the future) be found: (1) In the recovery of oils from drainage water, as already has been proposed; (2) in the prevention of gas-house and refinery pollution, which prevention should be helped by the increased use of "wastes" in by-products;

and (3) in prevention, by international arrangements, of the dumping of oil from ships in harbors or in the region of spawning grounds or special feeding areas.

FISH COOKERY.

"The last word on fish cookery" has just been given to the public by Messrs. Little, Brown & Company of Boston, in a volume on "Fish Cookery" by Evelene Spencer and John N. Cobb. Mrs. Spencer, after spending much time demonstrating fish cookery in the city of Portland, Oregon, in connection with its municipal fish market, was engaged by the government during the "Eat More Fish" campaign, to travel through the country, explaining the food value of fish and the desirability of using the less familiar species, illustrating her lectures by various methods of cooking this food.

Mr. Cobb, the co-author, is director of the College of Fisheries, University of Washington, Seattle, and the author of numerous works on the fisheries. He has contributed valuable information as to the fish themselves, and tables as to their food value, their location, seasons, etc.

The book contains more than 600 recipes for cooking fish and its accompanying sauces and dressings. Every conceivable manner of serving fish is described, treating not only the subject of the common and well known varieties, but numerous little-known and seldom used varieties as well, which contain equally valuable food properties. This last word on fish cookery should serve to bring that little appreciated branch of the art into its proper place in the preparation of a well-balanced menu.

UNITED STATES TOPOGRAPHIC MAPS.

Every hunter and fisherman who goes to the mountains should carry with him a United States topographic map. From these maps he may obtain information relative to streams, lakes, springs, elevations, and even cabins and other civilized ions. There are few states where h use is made of unsettled districts ur state, and it is quite important l areas open to the summer vaca- should be properly mapped. At sent time one may secure suitable phic maps of almost any area on ert and in the Sierra, and one may rom the Mexican line as far north nt Reyes utilizing a government The area to the north of Point however, is still unmapped, almuch used as a recreation ground. pressure brought to bear on the U States Geological Survey would assure the completion of the series of maps now available.

FACTS OF CURRENT INTEREST.

The California fisheries production for 1921 was 123,192,193 pounds of fish and 5,310,251 pounds of shellfish, making a total of 128,502,444 pounds. The total production for 1920 was 213,847,825 pounds.

With the increased rainfall the past year has come a splendid run of steelhead trout in the coastal streams.

The 1921 sardine catch was 59,332,305 pounds, which was only one-half as large as the 1920 catch.

The principal decrease in the fish catch noted in 1921 was of varieties used for packing purposes. Of the 128,502,444 pounds of fish and mollusks taken in California during 1921, approximately 66 per cent was used for canning and packing purposes, 30 per cent was used in a fresh state, and the remaining 4 per cent consisted of mollusks and crustaceans.

The salmon catch in California in 1919 was 13,145,727 pounds; in 1920, 11,133,819 pounds, and in 1921 it was only 7,990,932 pounds. A decreased catch is shown in all the salmon-fishing districts of the state.

Severe weather during February necessitated the feeding of quail and deer in many sections to prevent their starvation.

Spawning operations for the past season have been fairly successful considering the severe weather. A good take of eggs is assured.

Computation shows that the California Fish and Game Commission has planted more than 1,128,800,000 fish in the streams and lakes of this state.

COMMERCIAL FISHERY NOTES.

N. B. SCOFIELD, Editor.

CHICAGO, MINNEAPOLIS AND ST. PAUL AS FRESH FISH MARKETS.

The United States Bureau of Fisheries has just issued an economic circular entitled "Trade in Fresh and Frozen Fishery Products and Related Marketing Considerations in Chicago, Illinois," and another with a similar title but for the twin cities, Minneapolis and St. Paul. These circulars are by L. F. Hopkinson, agent of the bureau. The reports are quite complete and of great interest to all who may be interested in the marketing of fresh and frozen fish.

Chicago gets its fresh fish supply principally from Canada, the Great Lakes and the north Pacific Coast. A million and a quarter pounds of ciscoes, chubs and yellow perch were landed by Chicago commercial fishermen fishing in Lake Michigan during the last fiscal year. With the exception of halibut and salmon from the Pacific Coast and shucked oysters from the Atlantic Coast, the consumers prefer fresh water varieties. Seventy per cent of the fish trade is confined to eleven species, as follows: Buffalo-fish, carp, ciscoes, halibut, lake trout, pike or "jacks," salmon, whitefish, yellow-perch, yellow-pike and shucked oysters.

It is interesting to note that the two principal varieties consumed are the carp and a fish closely related to it, the buffalo-fish. The buffalo-fish come from Minnesota, Illinois River, Mississippi River and other nearby rivers, and are shipped to market "in the round" in 100- to 150-pound boxes and in barrels of 200 pounds each. The carp come from the same source and from the Great Lakes. They are shipped both "in the round" and dressed, in boxes and barrels. Shad are popular during season, but the supply, coming from Baltimore, Md., New York, N. Y., Florida and California, is limited.

Fish arrive in Chicago mostly in carload lots, both fresh and frozen. During the year ending July 31, 1921, a total of 526 carloads was received from Canada, as against 272 from the United States. During the same year a total of 19,643,047 pounds of frozen fish was placed in Chicago public cold-storage warehouses, while 20,104,072 pounds were withdrawn during the same period, there being a little over 7,000,000 pounds held over from the previous fiscal year.

The Bureau of Fisheries has also issued economic circulars setting forth the results of similar fish-market surveys in the cities of Louisville, Ky., and Pittsburg, Pa.

COLD STORAGE FISH.

Apparently there is very little prejudice in Chicago against cold storage fish, and that is as it should be, for it has been shown by investigations of federal bureaus that if fish are frozen soon after landing them from the fishing boats they can be kept frozen for several months in cold storage houses and still reach the consumer in better condition than if delivered direct without freezing.

Very nearly all kinds of fish have their seasons of greatest abundance followed by a period of scarcity. To freeze the fish at times when they are abundant and the markets oversupplied, and carry them over into the period of scarcity, increases their consumption and prevents the dumping of fish which so often happens on account of an oversupply of the market. The fishermen also would get a more nearly just reward for their labor and the public would get its fish at a less price.

The greatest need in the fresh fish industry in California is undoubtedly better freezing and cold storage facilities at the fishing centers. Such plants are being installed very slowly. What is needed to hasten the movement is to convince the public that the fish reach them in better condition if frozen immediately after catching. It will be necessary, however, to freeze the fish immediately after catching, and not after a few days' waiting to find a market, as it must be admitted there is a temptation to do.

CALIFORNIA SARDINES CONSIDERED HERRING BY CHILEAN CUSTOMS OFFICIALS.

The Fish and Game Commission's attention has been called to the fact that the customs authorities of Chile have ruled that California "pound oval" sardines are herring, and propose to collect the $1.20 per kilo herring rate on importations from California, instead of the 30 cents per kilo sardine rate to which our canners claim they are entitled. The higher herring rate of $1.20 per kilo, California canners say, will make shipment of our sardines to Chile impossible.

The California sardine is a true sardine scarcely to be distinguished from the sardine of Europe, and should not be confused with the species of herring which are being canned in other places and labeled as sardines. The scientific status of the California sardine and its relation to the other species of sardines and "sardine herrings" is set forth by Mr. Will F. Thompson in the October, 1921, issue of this magazine, in an article entitled "The Sardine of California." It is there shown very clearly that the California sardine (*Sardina coerulea*) is a true sardine. An article to the same effect by Professor E. C. Starks of Stanford University appeared in the April, 1918, number of this magazine.

The Fish and Game Commission is taking the matter up with the Chilean authorities, with the hope that they will give our fish the proper designation of "sardine." At the request of some canners the commission has issued a certificate to the effect that our fish are true sardines and not herring.

WORK OF THE CALIFORNIA LABORATORY OF THE BUREAU OF FISHERIES.

During the past fiscal year, while the Bureau of Fisheries' experimental laboratory at San Pedro was being operated by the Fish and Game Commission, investigations were carried on to determine what changes take place in the "fry bath" oil used for frying sardines. A report on this work is being published by the commission (circular No. 1).

In frying the large sardines for packing in pound cans, as it is practiced in the industry, the fry-bath oil quickly becomes dark in color and imparts a distinct and not altogether agreeable flavor to the sardines being fried. This oil has to be frequently discarded, and on that account contributes very materially to the expense of canning. It was therefore the object of the work at the bureau's laboratory to find some way, if possible, to purify and reclaim this oil and find out what changes caused the peculiar odor and taste in the oil and to devise some way to remedy it.

Several different oils have been used by the industry for frying the sardines, but cottonseed oil is the one commonly used. In the experiments it was found that corn oil or a hydrogenated oil does equally as well. In regard to the changes which take place in this fry oil, it was found that when fat sardines are fried—and the larger sardines are usually fat—the fry oil in a very short time becomes largely sardine oil. It is the presence of sardine oil in the fry bath which causes most of the trouble it was sought to correct. Sardine oil becomes easily oxidized by heat and contact with the air, and it is oxidized sardine oil which imparts the slight odor and taste to the canned product. No way was found to prevent the sardine oil from getting into the fry oil, and no economical means was found of purifying and reclaiming the fry oil or of preventing the oxidation of the sardine oil in the process of frying. The investigator, Mr. Beard, considers it improbable that any cheap successful means will be found.

The negative results of the experiments in purifying and reclaiming the fry-bath oil forced Mr. Beard to the conclusion that the best way to avoid the disagreeable taste imparted to the sardines and to lessen the cost of packing was to eliminate the process of frying in oil. The work of the laboratory during the present fiscal year has been largely devoted to methods of packing sardines in which oil frying has been eliminated. In these experiments the sardines were precooked in steam and in boiling brine, and they were also packed without precooking. It is believed that a method has been found which will lessen the cost of packing and at the same time result in a better pack, one which will be more palatable and digestible, and will "stand up" in shipping as well or better than the "fried in oil" pack.

The Bureau of Fisheries laboratory has issued pamphlets to California canners describing this method, and sample cans will be furnished to canners if they are interested. The results were given immediately to the canners, so that they might try out the method during the present season.

The California sardine is a very excellent fish and deserves a high place among the canned foods of the United States. It seems necessary, however, that improvements be made in the pound oval pack and that an organized publicity campaign be launched if the California sardine is to win the place in the minds of the people of the United States which it deserves.

LIFE HISTORY NOTES.

LARGE MACKINAW CAUGHT IN DONNER LAKE.

Anglers in the Truckee basin continue to occasionally catch the mackinaw trout (*Cristovomer namaycush*). On July 26, 1921, Mr. W. B. Gelatt caught a 12-pound mackinaw trout in Donner Lake, using minnow chubs for bait.

The mackinaw trout was first planted in Lake Tahoe in 1895, and a year later in Donner and other nearby lakes, after the successful hatching of a shipment of eggs

Fig. 60. Mackinaw trout, weighing 12 pounds, caught July 26, 1921, in Donner Lake by W. B. Gelatt. Mackinaw trout was introduced into the waters of this lake in 1895, but the annual catch is very small.

Although fish of this species are occasionally caught in lakes of the Truckee basin, the mackinaw, or Great Lakes trout, as it is sometimes called, has never thrived to the extent expected when introduced into this part of the country. This season, however, an unusual amount of large trout, ranging from 5 to 15 pounds, have been caught in Donner Lake.—GEORGE NEALE, Sacramento California.

WHITE PELICANS MEET DEATH DURING COLD WAVE.

Investigation authenticated a report in late January that numerous white pelicans were found dead on the shores of Lake Washington, near Sacramento. Local observers stated that the extremely stormy weather was responsible for the death of the pelicans. The terrific north wind appeared to render the birds helpless, and many were unable to rise after being blown down on the ice, which was several inches thick, or against wires. After the storm more than twenty-five of the pelicans were found dead along the shore of the lake.—GEORGE NEALE, Sacramento, California.

CONSERVATION IN OTHER STATES.

OREGON KILLS SEA LIONS.

During the past year the Oregon Fish Commission at the request of commercial fishermen, has attempted to exterminate the Stellar sea lions in the colonies along the Oregon coast. For this purpose a special boat was secured and equipped. The slaughter of these mammals is defended on the claim of the fishermen that the sea lions destroy large numbers of young salmon. It is to be hoped that the stomach contents of the animals killed is being carefully analyzed, for when an investigation was ordered a number of years ago here in California, on the complaint of fishermen, the sea lions killed were found to contain squids and octopi rather than salmon.

CONSERVATION IN EDUCATION.

"Education is perhaps the greatest one factor in aiding conservation. Undoubtedly the teaching of the principles of wild-life protection in the public schools will have a wonderful restraining effect upon the coming generation. The Wisconsin Game Protective Association is endeavoring to have a law enacted providing that Wisconsin school children shall be given instruction in the conservation of fish and game as a part of their regular school courses.

An effort should be made in all states by sportsmen's associations to have laws of this nature passed. At the present time Nevada is the only state we know of that has a law requiring that conservation be taught in the public schools of that state." — (R. P. Holland, Field and Stream, May, 1921, Vol. 26, No. 1, p. 33.)

OREGON HAS ADOPTED NEW GAME CODE.

At the last session of its legislature the State of Oregon adopted a new game code, the outstanding feature of which is the increase in license fees for both hunting and angling to $3, with the provision that a combination hunter's license and angler's license may be obtained for $5. With the increased income from license fees the commission expects to improve its patrol service and to increase its hatcheries from five to fourteen.

WISCONSIN'S BUCK LAW FAULTY.

Wisconsin is unfortunate in the wording of her new buck law, which provides that only bucks not less than one year of age can be lawfully taken. As a result sportsmen are continually writing the Conservation Commission, asking for some means of identifying a year-old buck deer. In that according to law a deer can not lawfully be killed until it is one and one-half years old, since fawns are born in May and June, the Conservation Commission has recently instructed its wardens that all deer with horns less than 3 inches in length, found in the possession of a hunter, are fawns and are to be confiscated. An attempt will be made to amend the law at the next legislative session to provide for a certain length of horn.

AUSTRALIA ESTABLISHES REFUGE.

The establishment of Wilson's Promontory, a national sanctuary in Australia covering about 101,000 acres of mountainous country, will provide protection

for many birds and become the last refuge for the Lyrebird, which has been so persecuted by the plume-hunter, the egg-collector and the fox.

NATURE PROTECTION IN JAPAN.

Japan is directing her attention very seriously to the protection of her animal life. Certain animals peculiar to Japan are in grave danger of extermination. Such are the Japanese ibis, Japanese egret, the Siberian bustard and the spoonbill. The Ministry of the Interior of the Empire of Japan has issued a brochure containing a list of the monuments, ruins, sites and places, and of the animal life, which it is desired to protect. — Bird Notes and News, Vol. IX, p. 53.

NEW MEXICO HAS NEW GAME LAWS.

At the last session of the New Mexico legislature the game laws were completely revised and a new commission appointed. The commission is composed of three members, not more than two of whom shall be of the same political party, appointed by the governor. The terms are for six years and are overlapping, so as to assure continuity of policy. The commissioners serve without pay. The chief warden is also appointed by the governor.

The commission is granted regulative powers in addition to those of law enforcement. The new law describes the various functions as follows:

To establish game refuges for the purpose of providing safe sanctuaries in which game may breed and replenish adjacent hunting ranges.

To declare closed seasons in any specified locality on any species of game or fish threatened with undue depletion from any cause.

To purchase land for game refuges and public hunting grounds, particularly suitable for waterfowl hunting.

To designate resting grounds for waterfowl, in which they shall not be molested.

To close waters to fishing, for the protection of recently stocked streams, spawning waters or depleted waters.

To establish fish hatcheries.

To prohibit hunting in periods of extreme forest-fire danger.

To propagate, purchase and sell game animals, birds and fish for restocking.

To withhold license privileges for not to exceed two years from any person procuring a license through misrepresentation or hunting without a license.

The commission is not authorized to open any closed season established by the legislature, to lengthen any open season, to declare a closed season on any predatory species, or to increase any bag limit.

GAME CONDITIONS IN BRITISH COLUMBIA.

A report of game conditions for 1920 by the Game Conservation Board of British Columbia chronicles several changes in the game laws in an endeavor to better conserve game. In northern British Columbia the bag limit on mountain sheep has been reduced to two rams of any one species or three in all. In the southern part of the province only one ram may be killed. Wapiti are being given a closed season in southern British Columbia. Sentiment favoring a buck law is gaining ground rapidly. Even the grizzly bear is being accorded a measure of protection, being entirely protected south of the main lines of the Canadian Pacific Railway, and a bag limit of three being allowed for the region lying to the north. As might be expected, the catch of fur was comparatively small, the 1842 trappers reporting a take of 110,573 pelts.

REPORTS.

STATEMENT OF EXPENDITURES.

Period July 1, 1921, to December 31, 1921.

Function	Materials and supplies	Salaries and wages	Service and expense	Property and equipment	Total
Administration:					
Commissioners			$563 33		$563 33
Executive offices	$434 54	$9,376 43	2,931 56	$12 00	12,754 53
Printing			4,212 30		4,212 30
Research and publicity	242 00	2,050 00	384 01		2,676 01
Accident and death claims			11 28		11 28
Department totals	$676 54	$11,426 43	$8,103 48	$12 00	$20,217 45
Commercial fish culture and conservation:					
Superintendence	$282 76	$5,047 50	$2,711 20	$378 21	$8,419 67
Inspection and patrol	2,434 21	10,290 00	2,297 09	33 90	15,055 20
Research	524 20	9,832 67	2,796 19	1,772 28	14,925 34
State laboratory construction	12,779 72	9,855 77	373 32		23,008 81
Statistics	398 00	3,849 49	152 39	184 15	4,584 03
Market fishing license commissions			320 00		320 00
Propagation and distribution of salmon	4,591 14	10,840 12	1,438 42	765 30	17,634 98
Department totals	$21,010 03	$49,715 55	$10,088 61	$3,133 84	$83,948 03
Sporting fish culture and conservation:					
Superintendence	$415 58	$6,410 41	$17,824 93	$28 05	$24,678 97
General patrol (40 per cent)	356 35	25,686 57	18,711 20	3 88	44,758 00
Propagation and distribution of trout	21,325 55	33,922 48	20,627 43	5,321 39	81,196 85
Department totals	$22,097 48	$86,019 46	$57,163 56	$5,353 32	$150,633 82
Game conservation:					
General patrol (60 per cent)	$559 13	$38,819 50	$46,438 04	$5 82	$85,822 49
Tahoe camping ground	$14 55	$603 00	$14 75	$2 50	$634 80
Grand totals	$44,357 73	$166,583 94	$121,807 44	$8,507 48	$341,256 50

Seizures.

Game.

Deer meat	281½	pounds
Deer, ———	5	
Deer	751	pounds
Deer and valley quail	34	pounds
Valley quail	93	
Ducks	1,612	
Geese	38	
Golden plover	1	
Spike buck	2	
Wild pheasants	3	
Meadow larks	7	
Swan	1	
Sage hens	19	
Shore birds	8	

Fish.

Abalones	508	
Dried abalones	41	pounds
Brant	9	pounds
Bass, black and striped	38	
Bass, striped	643½	pounds
Clams	324	
Crabs	191	
Crab meat	14	pounds
Crawfish	1	
Halibut	200	pounds
Croaker -yellowfin	300	pounds
Lobsters	841	
Salmon	29	
Smelt	75	pounds
Trout	17	
Trout	66	pounds
Trout, smoked	50	and 2 boxes

Illegal nets 13 $1,235 00

Searches.

Game 7

CALIFORNIA FRESH FISHERY PRODUCTS FOR MONTHS OF OCTOBER, NOVEMBER AND DECEMBER, 1921.

Compiled by Fish and Game Commission, Department of Commercial Fisheries.

Species of fish	Del Norte, Humboldt	Mendocino, Sonoma, Lake	Marin	Solano, Yolo	Glenn, Tehama, Colusa	Sacramento, San Joaquin	Contra Costa, Alameda	San Francisco, San Mateo	Santa Cruz	Monterey	San Luis Obispo, Santa Barbara, Ventura	Los Angeles	Orange	San Diego	Imperial	Total	Mexican, brought into California
Albacore												520,411				520,411	
Anchovies								33,295		7,400		1,000		1,000		42,695	
Barracuda								71			68,432	98,461		91,559		258,523	1,159,017
Bluefish									7,528	17,138						24,666	
Barracuda								5,227	37,927	176,523	4,415					224,092	
Bonito									7	7	7,362	83,199		10,019		100,594	56,936
Carp				340		5,592	831									6,763	
Catfish		41,880				1,381										43,261	
Chilipepper								933	100,172	50,001						151,106	
Coltus Cod	215		116					61,334	4,503	56,539				890		123,597	
Dolphin																	
Eels																	
Flounders	2,480		10	302			983	51,375	12,125	1,298		1,619		640		70,832	773
Graylish							377	26,507	774	20	800			13,402		41,880	
Greenfish																	
Hake								22,120	7,150							29,270	
Halibut	1,350						38	11,624	1,394	986	48,099	84,477	232	49,210		197,372	373,927
Hardhead						13,784										13,822	
Herring	2,192		7,133				4,837	53,188								67,350	
Kingfish								150	10,527	6,091	565	64,062		1,580		82,965	905
Mackerel									129	67,330	28,136	648,894	6,195	32,220		782,904	27,815
Marlin																	
Mullet														4,942	288	5,230	4,145
Perch	3,667		3,210				13	19,567	23	780		25,556	336	459		53,611	6,527
Pike				32		637	1,783									2,422	
Pompano								2,087		42	15	4,409				6,523	
Rock Bass											37	54,864	1,026	7,489		63,416	2,864
Rockfish	257							163,760	90,779	197,236	21,161	239,816	12,045	104,813		829,867	16,351
Sablefish								53,938	63,439	6,007						123,384	
Salmon	367,089		833	10,076		8,912	2,332	218								389,440	
Sardine								180,740	41,150	160		2,885				194,935	
Seabass								96,602	1,269,315	14,237,919	2,000	14,206		373,076		15,991,118	
Seaperch												13,881		2,642		16,483	
Sea Trout—Black											2,190	3,237		18,874		36,291	13,486
Sea Trout—White								14,641	1,626	18	11,624	89,678	192	20,428		138,187	201,796
Smelt											880	15	3,033	138		3,883	3,600
Shark				1,798		2,188	19,922	23								23,977	
Ray				156			10									166	

Shovelhead											53	1,263		2,601		3,917	
Skates								18,253	1,500	240		475	25			20,493	
Skipjack									95			56,256				56,351	
Smelt	9,212		5,059					14,659	3,692	30,500	6,439	52,042	109,088	8,859		239,550	7,304
Splittail								1,224,916	275,911	2,375	1,767	10,418	7	3,386		1,518,780	537
Striped Bass						440	49									489	
Stingaree			117	18,661		15,505	119,233	339								153,855	
Suckers														1,215		1,215	
Surf Fish						2,097										2,097	
Swordfish																	
Tomcod												733				733	
Trout—Farm								6,257	1,950							8,207	
Trout—Steelhead	3,605															3,605	
Tuna												88,380		3,082		91,462	115,695
Tuna—Bluefin												55,357				55,357	
Tuna—Yellowfin												22,419				22,419	31,458
Turbot																	
Whitebait								1,835								1,835	
Whitefish												7,130		1,139		8,269	200
Yellowtail											627	613,716	188	255,732		870,263	211,705
Miscellaneous	15						151	31,785	8,092	3,752	11,553	16,860		5,258		77,466	2,267
Total fish	390,062	41,880	16,478	31,362		50,503	150,510	2,063,414	1,939,808	14,862,332	215,755	2,877,699	131,367	1,014,650	288	23,786,108	2,236,810
Crustaceans:																	
Crabs (dos.)	622	75	306				13	13,886								14,902	
Crayfish (dos.)																	
Shrimps			111,064				44,467	94,926				671				251,128	30
Spiny Lobsters											32,923	121,087	5,388	108,379		267,777	241,812
Mollusks:																	
Abalones										264,590	4,362					268,952	
Clams—Cockle	1,210		1,017													2,227	
Clams—Mixed	5,069		8,254				1,305									14,628	
Clams—Pismo									405		30,556					30,961	
Clams—Softshell		279	13,361				25,567	12,305								51,512	
Cuttlefish								1,420	283	12,821		156				14,680	
Limpets																	
Mussels							636	389		2,825	40					3,890	
Oysters—Eastern (No.)			1,185,310													1,185,310	
Oysters—Native																	
Snails										80,422		2,838				83,260	
Squid																	
Miscellaneous:																	
Frogs (dos.)																	
Terrapins (dos.)										75		160				235	440
Turtles																	

All amounts shown in pounds unless otherwise specified. Albacore and Skipjack cleaned. All other fish in round.

VIOLATIONS OF FISH AND GAME LAWS,

October 1, 1921, to December 31, 1921.

Offense	Number of arrests	Fines imposed
Game.		
Hunting without a license	37	$382 50
Hunting in game refuges	8	80 00
Hunting in posted grounds	5	85 00
Hunting out of season	4	255 00
Trapping without a license	2	20 00
False statement to secure license	2	30 00
Birds: non-game—possession and killing	29	295 00
Deer, male, possession, closed season	10	750 00
Deer meat, possession, closed season	12	150 00
Does, killing and possession	8	800 00
Fawns, killing and possession	3	200 00
Doves, killing and possession	4	30 00
Ducks, overlimit, possession, killing, closed season	10	465 00
Rabbits, possession, killing, closed season	6	135 00
Pigeons, possession	1	----------
Wild pheasants, killing and possession	2	50 00
Spike buck, killing and possession	3	200 00
Yellow hammers, killing and possession	12	30 00
Shore birds, shooting and possession	27	200 00
Snipe, killing and possession	5	125 00
Paws of bear, possession	2	20 00
Wild geese, excess limit	2	50 00
Swans, killing	1	25 00
Sea gulls, killing	1	10 00
Killing game in game refuge	3	300 00
Plover, shooting	1	65 00
Excess bag limit	8	275 00
Shooting from auto	3	25 00
Shooting from power-boat	12	175 00
Quail, possession, closed season, killing	17	350 00
Failure to keep heads and horns in possession	1	----------
Hides, possession, illegal	3	75 00
Night hunting	59	1,055 00
Total game violations	303	$6,658 50
Fish.		
Bass, possession, excess limit, undersized	18	$250 00
Crabs, closed season	2	15 00
Crab meat, possession, closed season, selling out of shell	2	50 00
Abalones, possession, undersized, overlimit	12	375 00
Abalones, gathering for profit without license	2	----------
Crackers, yellowfin and spotfin	1	75 00
Crawfish, oversized, buying and possession	2	20 00
Halibut, undersized	1	25 00
Lobsters, undersized, possession	10	165 00
Salmon, overlimit	1	100 00
Trout, possession, overlimit, closed season	5	225 00
Night fishing	20	465 00
Shipping fish by parcel post	4	100 00
Fishing without a license	10	125 00
Fishing without a license (commercial)	2	45 00
Fishing within half-mile of spawning station	3	60 00
Taking and possession fish within 250 feet of fishway	3	75 00
Fishing within 750 feet of wharf	1	50 00
Using fence for taking salmon	1	25 00
Clams, overlimit, undersized	14	305 00
Placing obstruction in stream	2	50 00
Discharging sawdust in stream	1	50 00
Depositing petroleum in California waters	1	----------
Allowing dogs to run wild and more than one dog per person	3	70 00
Total fish violations	121	$2,880 00
Grand total fish and game violations	424	$9,539 50

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CALIFORNIA FISH AND GAME

"CONSERVATION OF WILD LIFE THROUGH EDUCATION"

Volume 8 SACRAMENTO, JULY, 1922 Number 3

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MIGRATING SALMON AT THE REDDING DAM.

By E. A. McGregor.

In connection with a lawsuit brought by the Fish and Game Commission against the Anderson-Cottonwood Irrigation District, owing to the alleged stoppage of salmon migration by the Redding Dam (on the Sacramento River near Redding), the writer was delegated to conduct an investigation of the dam from the salmon standpoint. The following observations have been extracted from the writer's report on his findings at the Redding Dam with the thought that they might prove of interest to readers of California Fish and Game.

The period covered by the investigations was from September 14 to October 7, 1921, inclusive. During this time the flash-boards were nearly all in place so that the dam constituted about as much of a

barrier as is ordinarily the case. It was ascertained, moreover, that this had been the approximate condition of the dam since the beginning of irrigation in the spring.

Nature of dam.

The Redding dam (Fig. 61) is constructed fundamentally of concrete, but carries a steel superstructure which in turn supports a system of flash-boards. In detail the dam construction is as follows: A continuous concrete base or apron extends from shore to shore completely across the river—running nearly north and south. The dimensions of this base are: Three feet thick by 26 feet wide by about 440 feet long. Rising above this apron (Fig. 62) are 67 concrete piers with a clearance between them of five feet six inches.

FIG. 61. View of dam from south shore looking northward. Flash-boards practically all in place. This condition exists from spring until about the middle of October.

Each pier is about 12 inches thick, rises slightly over 10 feet above the upper face of the apron, has a basal length of 24 feet and a top length of eight feet, resulting in angled buttresses both upstream and downstream. Each pier contains a deep cavity (see Fig. 63), about four inches wide and six feet deep which receives the folding super-frame.

Each pier carries a superstructure of steel. This consists of a braced frame which hinges at the top of the upstream face of the pier. It is so constructed that it can be either elevated to carry additional flash-boards or dropped into the pier cavity so as to be flush with the top of the pier. The vertical height of this superstructure above the

FIG. 62. Piers Nos. 2, 3 and 4 and ports Nos. 1, 2 and 3. Taken near north end of dam looking southwest. Boy spearing in pier pocket for trapped salmon.

FIG. 63. *Compartments 2* and 3, showing top of pier No. 2, with cavity so fatal to salmon.

concrete p… pproximately five feet six inches. Thus, the entire height of … crest above the basal apron is about fifteen feet eight inches.

Detailed … of compa… At the time of our first visit to the dam, and continuously thereafter throughout the investigation, the specific arrangement of each of the 68 dam compartments was as follows:[1]

—Condition of Compartments During Investigation.

Compartment number	…moved	Inches of wa'er above top board	Compartment number	Boards removed	Inches of water above top board
1	e	2	35	None	3
2		24	36	None	0
3				None	0
4				None	3
5				None	2
6				None	3
7				None	4
8				None	5
9				None	3
10				None	2
11				None	1
12				None	0
13				None	0
14				None	0
15				None	0
16				None	0
17				None	1
18				None	2
19				None	4
20		0		None	0
21	None	0		None	0
22	None	1		None	5
23	None	2		1	8
24	1	12	58	1	10
25	1	8	59	1	10
26	7*	66	60	2	16
27	7*	66	61	2	16
28	None	0	62	None	1
29	None	0	63	None	1
30	None	½	64	None	2
31	None	0	65	None	0
32	None	0	66	None	0
33	None	2	67	None	1
34	None	1	68	Part of 1	10

*Sections 26 and 27 comprise the spillway.

On one occasion a light rain raised the river level at the dam about two inches. With this one exception, the above table indicates the flow over the dam during our investigations. Only nine compartments had a foot or more of water passing over their respective crests. These were compartments numbers 2, 3, 4, 5, 24, 26, 27, 60 and 61. The remaining 59 compartments, for the most part, had only thin films of water passing over them and thus obviously precluded the slightest possibility of the passage of fish therethrough.

Compartments numbers 26 and 27 (see Fig. 64) constitute what the Anderson-Cottonwood irrigation authorities choose to term the "fishway;" in these compartments all the flash-boards were out down to the pier level. Compartments numbers 2, 3, 4 and 5 are at the extreme northern end of the dam. They offer the best leaping possibilities and they will be discussed hereafter at greater length.

[1]We have arbitrarily numbered the compartments of the dam, commencing at the northern end, from 1 to 68, inclusive.

Method employed. The method adopted whereby specific data could be accumulated, capable of demonstrating beyond any doubt the ability or non-ability on the part of salmon to clear the various compartments of the dam in the course of their spawning migrations, was as follows: One compartment at a time was carefully watched for a period of 15 minutes; the total number of leaps and the number gaining the crest of the dam were noted in each period.

FIG. 64. Spillway from a point 35 feet to the southward. Camera about four feet above level of dam crest.

In all but the spillway—comprising compartments numbers 26 and 27—this method, from the first, proved entirely convincing and trustworthy. However, there were those who maintained that, owing to the depth of water passing through sections 26 and 27, it was possible for salmon to penetrate the down-rushing water without being detected by the eye of the observer. The writer realized that this contention might be employed by the dam authorities and sympathizers to the great embarassment of those trying to establish the case for the fishway.

Visibility through water. Rather early in the investigation the writer discovered that during a portion of the forenoon from about 9 a.m. to about 11 a.m.—the sun's rays struck the crest of the dam at such an angle as to sufficiently illuminate the topmost remaining plank at the bottom of the spillway. During this interval, with one's back toward the sun, there were no confusing reflections or refractions from the upstream (western) direction, and

the visibility to the bottom under these conditions was all that could be desired.

In other words, when one took advantage of the most favorable conditions, *it was possible to be certain* for every compartment, *whether or not salmon were passing* to the still water above the crest of the dam.

Use of water-glass.

Through conferences with Messrs. Shebley, Scofield, Duke, Doney, Lambson (of the Commission), and Rich and Hancock (of the U. S. Bureau of Fisheries), who visited the Redding dam during our investigations, there crystallized the idea of constructing a water-glass or hydroscope. Such a device was perfected by cementing a plain auto headlight lens into the end of an eight-inch galvanized sheet-iron casing. Tests of

FIG. 65. View at spillway looking northward. Observer peering through six feet of water by means of water-glass.

this device at the so-called "fishway" were highly satisfactory. Through the employment of the hydroscope—especially in the forenoon—the visibility through the entire depth of the spillway (see Fig. 65) became excellent. *No passing salmon during the use of the water-glass could escape detection.*

Detailed data on leaps.

The following table has been prepared from the accumulated data secured in connection with the numerous fifteen-minute counts. It summarizes the information concerning the leaping of salmon at the dam:

TABLE II.—Summary of Observed Salmon Leaps.

Section numbers	Number of 15-minute observations	Total leaps observed	Average leaps per 15-minute observation	Number of fish clearing dam	Estimated leaps in 12 daylight hours
1	3	8	2.66	0	127.68
2	59	1,644	27.86	9	1,337.28
(2 and 3)*	(2)	(65)	(32.50)	0	
3	36	195	5.42	1	260.16
4	3	1	.33	0	16.00
(4 and 5)*	(2)	(6)	(3.00)	0	
5	7	13	1.86	0	89.28
24	1	4	4.00	0	192.00
25	2	3	1.50	0	72.00
(25 and 26)*	(1)	(4)	(4.00)	0	
26	9	27	3.00	0	144.00
(26 and 27)*	(13)	(90)	(6.92)	0	
27	12	54	4.50	0	216.00
(27 and 28)*	(1)	(8)	(8.00)	0	
30	1	0	0	0	0
40	1	0	0	0	0
41	1	0	0	0	0
47	1	0	0	0	0
60	3	0	0	0	0
61	2	0	0	0	0
67	2	0	0	0	0
68	3	10	3.33	0	160.00
Totals	165	2,132		10	

Leaps per twelve-hour day, 2,614.40. Per cent clearing dam, .469.

*On a few occasions the observer watched two compartments at a time.

From the foregoing table it will be seen that in the course of 165 fifteen-minute observations 2132 leaps were observed. Out of this number only 10 fish managed to gain the crest of the dam. This yields a percentage of .469 (less than half of one per cent, of successful leaps. Based on our data, it is computed that approximately 2614 salmon leaps occurred each twelve-hour day during the course of our observations.[1] In other words, our data reveals that in the course of a twelve-hour day (daybreak to dusk) an average of 2614 salmon attempted to leap the dam; of these 12 (.47%) succeeded, while 2602 (99.53%) failed.

Night leaping doubtful.

From actual nocturnal observations, and from the declarations of fishermen, it seems established that very little, if any, leaping occurs at night. In an hour's close watch on a very bright moonlight night, not an attempted leap was seen. Furthermore, it is said that trapped fish are rarely taken from the pier pockets immediately after daybreak, which fact confirms the above contention. This, if true, would confine our considerations to the diurnal activities of salmon.[2]

[1]This figure represents a conservative estimate since we have assumed that 58 compartments are entirely unattractive for leaping.

[2]The nonoccurrence of salmon leaping at night has been corroborated by the declarations of the workers at the racks.

So far as our observations have progressed, we believe we may state that it is strongly indicated that all salmon individuals that were seen to gain the crest of the dam were small males, commonly called "grilse." They are spry and muscular (mostly between two and six pounds) and are unencumbered with surplus weight. The apparent failure of females to pass the dam is a point which deserves serious consideration in connection with normal upstream spawning activities. Furthermore, one can not help but note that the females, after "fighting" the dam, fall comparatively easy prey to the expert spearing fishermen.

Females barred.

By the very nature of the dam, constituting as it does an almost unsurmountable barrier, there is a resulting piling up or concentrating of salmon in the river immediately below the dam. This naturally facilitates fishing operations at this point on the river. The common methods of capture observed during the investigation were, namely, spearing, use of grabhook, set line, rod and reel and dip nets.

Dam barrier aids capture.

From the evidence adduced, the spearers (see Fig. 61) land about one out of five salmon hit. It is claimed—and it seems probable—that those injured and escaping have slight chance of recovery in the fungus-laden fresh water. The grabhooks are, like the spears, operated directly from the dam. In addition, they are used to extract the salmon which frequently fall into the cavities in the concrete piers. Spearers and others frequently employ setlines as a supplement to their other activities. Certain parties were observed using dip nets to trap the salmon as they fell back after attempted leaps. Tourists and sportsmen operated daily with rod and reel. Fishermen of all types have come to know that salmon concentrate below the dam during the period that the flash-boards are in place.

To the casual observer, the cruel battering against the dam is a more obvious realization than is the failure to gain the crest. As will be discussed later, the majority of the salmon fail to leap to the best possible advantage. Owing to the impact of the excessive drop of the water, much foam at the base obstructs the vision. As a result, the path of the leap is usually at an angle to the perpendicular to the crest (*i. e.*, to right or left of a direct upstream line). This results in innumerable cases of individuals crashing against the cement piers and the steel superstructure. We have seen salmon float helplessly following these collisions. Stunned fish occasionally strand on the pebble bar below the northern end of the dam.

Injuries sustained.

A more spectacular type of accident occurs when leaping fish fall into the cavities in the piers (see Fig. 63). In some of these the water escapes through holes below, too small, however, to permit the escape of the trapped salmon. All salmon falling into these pockets are doomed. Every day dozens of fish are extracted from these holes—many of them badly battered from their desperate endeavors in attempting to escape.

Pier holes are traps.

It is impossible to estimate the percentage of salmon which are destroyed through contact with the dam structures. It must be very heavy, however, and many observers believe that the majority of the migrating salmon continue to "fight" the dam until they perish.

Fungous disease.

A type of fungous disease is quite prevalent among salmon in the river, and it is probable that this disease is enabled, in part, to infect the fish through the abrasions caused by battering against the dam. We have seen badly infested salmon drifting weakly downstream above the dam, which fact indicates the influence the dam may exert on a certain number of individuals even after they have luckily leaped it.

Concerning the spillway.

The authorities in charge of the dam have selected compartments numbers 26 and 27 for the location of the spillway (see Fig. 64). With no little humor, they speak of it as the "fishway." From side to side this gap in the dam[1] measures 12 feet. The flash-boards are removed down to the level of the top of the concrete piers, so that nearly six feet of water passes over the topmost remaining plank. It is necessary to behold this spillway to gain a clear comprehension of its nature. Through the gap tumbles a crashing deluge. (This is true even at the low stage of the river.) Upon reaching the level of the river below, the torrent churns and boils in a fierce madness that resents resistance. Within a large fan-shaped zone adjacent to the base of the spillway there is a continual seething chaos.

Wary of spillway.

We have observed, and without surprise, that salmon do not often venture into this maelstrom. The great majority seem instinctively to avoid it. When rarely, an individual "stumbles" into the "boil," it is tossed about in a nearly helpless condition. The few leaps that are attempted therefrom are always abortive. The direction of these occasional leaps is about as likely to be away from the dam as toward it. The salmon appear instinctively to realize that they possess slight chance of leaping effectively from this spot.

During the many hours spent on the dam, the total recorded number of well-directed leaps at compartments numbers 26 and 27 (the spillway) have been few indeed. Most such attempts carried the individuals but two or three feet above the stream level and, upon contact with the spillway falls, were dashed hopelessly back again into the seething "boil" from which they rose.

Conditions bad below spillway.

We are reliably informed that the spillway was located where it is because of the fact that a large mass of stone occurs on the river bed immediately below this point. Whether this was placed there, or whether it is a natural dike is not established. This aggravates the turmoil below the spillway, causing an unfavorable shallowness there, and helps to defeat the intended purpose of the miscalled "fishway." It prevents erosion and back cutting which obviously explains why the dam officials chose this location for the spillway.

Water-glass at spillway.

By means of direct double observations, it was possible to establish positively that salmon can not and do not gain the crest of the dam at the spillway. These observations were conducted as follows. Our assistant watched carefully for attempted leaps at the base of the spillway falls for a certain period (usually 15 minutes). During this same interval the writer, by the use of the water-glass, gazed through the six feet of

[1]Obviously this gap in the dam functions as a spillway only when the flash-boards in the remaining compartments are in place.

water to the topmost remaining flash-board beneath the spillway. So perfect was the visibility when the hydroscope was employed that the passage of the smallest migrating fish could not escape detection.

An observation which contributes to prove that the spillway region is unfrequented by salmon, is the fact that the seasoned old spearers and other fishermen never operate at that portion of the dam (which they naturally would if the spillway functioned as an avenue of migration, as claimed by the dam authorities).

FIG. 66. North end of dam from down stream; camera directed up stream. Figures grouped above compartment No. 2, at which point most leaping occurs.

Most leaping at section number 2.

As has been previously recorded, compartment number 2 (at northern end of dam—(see Fig. 66) is conspicuously the point on the dam most preferred by the salmon for attempted leaps. As revealed in a following table, out of a total of 2132 observed leaps, 1644 of them took place at section number 2. This represents 77.1 per cent of all leaps recorded during the investigation. Clearly, there must be an explanation for this striking phenomenon.

One of the laws of hydraulics of a stream is, namely, that the flow is strongest at the center and weakest at the margins of the stream. Also, as the depth increases the current decreases, and vice versa. Now, compartment number 2, obviously, is at the margin of the river, and is immediately above the largest and deepest pool adjacent to the dam. It follows, then, from the above-quoted law, that the quietest water along the dam is to be found at this particular point. Moreover, the flash-boards of number 2 were so arranged that a vertical depth of 24 inches of water was spilling thereover. As will be developed later, it *is true that* newly arriving salmon "prospect" along the base of the

dam in an endeavor to locate the most propitious point for leaping. By elimination they ultimately select compartment number 2 as the point at which to center their efforts.

Too much emphasis can not be placed on our contentions that the above spot (compartment number 2 and vicinity) is the natural and most logical location for the construction of the proposed fishway (provided the topography of the river bed continues fundamentally as when our observations were made).

a. *Reconnoiter.* From our rather intimate studies of leaping salmon, we are convinced that the great majority of individuals examine the "falls" prior to attempting the leap. They are seen to swim directly into the base of the falling water and, returning, pass through it again. The theory suggests itself to us that some instinct or special sense enables the salmon to gauge the height and amount of water passing over the crest, by means of the impact experienced in these passages through the falls.[1] At the same time the individual ascertains, for the moment, the relative location of the obstacle to be cleared.

Salmon leaps analyzed.

b. *Initial leap.* When a salmon is thus observed cutting and recutting the base of the falls, it may be assumed with considerable certainty that the attempted leap is imminently at hand. After sufficient lapse of time to permit the individual to dive down to a chosen starting point, and to shoot upward to the surface, the recent "prospector" almost invariably essays its first leap (this applies only to compartments where conditions are at least remotely favorable.) Owing to the artificial nature of the Redding dam (and to its non-existence in the phylogeny of the Sacramento race), the necessary effort is always under gauged in the case of the initial leap. The result is, at best, a four- or five-foot jump.

c. *Subsequent efforts.* The delay or non-delay of the later leaps depends on the success of the initial attempt. Individuals that strike the falls in a well directed manner immediately "gather themselves together" and repeat the leap with very little delay—often within 10 or 15 seconds. In cases, however, (and they are very frequent) where the first leap results in contact with the cement piers, steel superstructure, or the downstream face of the flash-boards, the individual's "spirit" seems to be "broken," for the time, and these fish are not observed to leap again soon. It should be added that an individual usually advances with each succeeding leap until either it gains the crest (rare indeed) or wears itself out.

d. *Point of starting leap.* Owing to the structure of the dam, with the downstream projecting piers, the salmon are greatly handicapped in their leaping. As they dart upward through the water, in the momentum gaining portion of the leap, the submerged buttresses of the piers constitute, no doubt, a vital factor in determining the point of emergence from the water. Probably the majority of the leaps start from points below (*i. e.* downstream) the eastern margin of the buttresses. This necessitates an aerial leap of about eight and one-half feet in height and approximately eight feet in horizontal distance in order to gain the crest of the dam. As a matter of fact, the vast majority of leaps thus started become abortive since the trajectory of

[1]This may be one of the functions of the lateral line organs.

the fish meets the falling sheet of water at a right or descending angle.

e. *Direction of leap.* As has been previous'y recorded, the majority of the leaps are misdirected. The irregular outline of the dam—consisting of alternating buttresses and ports—is the factor most to blame, we believe, for this inaccuracy in leaping. This condition in no sense simulates the contour of a natural waterfall, and the salmon's instincts are unavailing as against the artificial barrier. The abundant presence of foam and "white water" work to aggravate this malcondition by obscuring the real location of the crest of the dam, which might otherwise be gauged through the fish's optic sense. Probably other senses, such as "direction of flow," "source of impact," and sound, are the chief guiding agencies.

Under a previous heading we have described the common occurrence of salmon diving headfirst into the piers and superstructure as a result of misdirected leaps.

f. *Height attained.* The great majority of the jumps are surprisingly futile. We would roughly estimate that the average height of all observed leaps is not in excess of three feet. Some individuals elevate themselves less than a foot above the water level. On the other hand, some remarkable leaps have been witnessed. Two small salmon (probably "grilse") were seen to strike against the plank footway which is about two inches higher than the crest of the dam. Another individual, whose leap was successful, actually leaped a trifle beyond the crest and struck the smooth water a few inches upstream. Such leaps as the two last mentioned, however, are so rare as to be hardly deserving of consideration.

g. *Successful leaps analyzed.* There seem to be two types of successful leaps. In one case the salmon leaps high and squarely toward the crest. The instant the fish cuts the water (immediately below the crest) it forges straight ahead through the utmost application of its swimming power. Usually in such cases the salmon is almost at a "standstill" at the moment of passing the crest.

In the other type of successful leap, the fish may not soar quite so high, but cuts into the falls at an angle toward the side of the compartment. It appears to flex or arch the body in such a way that the flow of the "falls" has a tendency to force the individual sidewise and upward—like a boat "quartering" against a current. Probably the initial momentum operates to assist in the ascent through the falling water.

In either case, upon gaining the crest, the fortunate individual dives quickly downward toward the zone of least flow.

a. *Arrival of a fresh school.* The arrival of a new school at the dam is quickly detectable. The individuals are much more active and they all seem to be "possessed" to leap at the same time, so that there is a condition at the dam approaching congestion. At such times, before the school has become badly dispersed through "fighting" the dam, it is a common sight to see the salmon leaping simultaneously in pairs. Just what they may gain by this phenomenon is difficult to see. The leaping pairs are frequently of the same sex.

Miscellaneous observations.

b. Fishermen's testimony. Several fishermen, of whom we solicited *opinions* relative to the passage of salmon over the Redding dam,

were in complete accord with Jean Barion—a pioneer fisherman of this region. In reply he asked: "Why would we journey miles down the river from our homes to fish at the dam if we could get fish up where we belong?" Jean's sentiment is a dramatic refutation of those who dare to claim that the dam is no serious barrier to the upstream movement of salmon.

The writer has repeatedly asked upstream residents what they knew concerning the prevalence of salmon above the dam—especially during the months when the flash-boards are in place. All have been agreed that they have become extermely scarce since the erection of the dam. Several keen observers informed me that they had seen no sign of mature salmon during the summer months.

c. *Net experiments.* With the idea of attempting to establish beyond doubt the precise number of salmon clearing a particular portion of the dam in a given time, the use of a net suggested itself. Accordingly, Mr. Wm. Shebley, Superintendent of Hatcheries, upon request, dispatched to the scene about 30 feet of small mesh seine. This was placed, by various means, just above the crest of the dam. Unfortunately the force of the current was such that the lead line was invariably swept down over the dam with the result that the normal activities of the fish were interfered with. In the course of these trials the net was rather badly torn and we were forced to abandon this phase of the investigation.

It appears that the only practical way of applying this idea would be to stretch a seine entirely across the river at a safe distance above the falls. Mr. Shebley stated that he had once figured on constructing a rack across the stream from shore to shore above the dam, but that lack of available funds had prevented the test.

We hasten to state, however, that measures so heroic as these are not needed to convince scientific observers that only a negligible percentage of the salmon run is able to pass the Redding dam. A test of the above sort would no doubt be convincing to open-minded persons, but probably not to the type of men who oppose fishways in general.

d. *Oxygen stimulation and leaping.* While we are recording observations independently arrived at, it may not be amiss to include the following theory. As we know, fishes breathe by means of the presence of free oxygen in the water. Immediately below a dam or falls there obviously is a superabundance of air—and consequently free oxygen—carried in the "white water." In the wonderful balance of Nature it may be that fish derive their marvelous leaping energy from the temporary stimulation exerted by means of this excess of oxygen *to be found in the very portions of the streams* where piscean energy is vitally needed.[1]

[1]In reading my manuscript, two authorities have criticized the above theory. They contend that physiologists have demonstrated that the red corpuscles of the blood are definitely limited in the amount of oxygen which can be taken up, and that this fact invalidates my theory. I am not ready to admit that my critics are correct. As a first counter argument I propose the possibility that in the more sluggish portions of rivers salmon may not secure the maximum supply of oxygen that is desirable from the standpoint of maximum energy, whereas, on the other hand, this optimum condition is found at points where the stream is greatly agitated. In other words, is it not possible that mature migrating salmon may secure such supplies of oxygen immediately below falls as to suffice for the utmost demand on their energy, whereas this condition is not elsewhere encountered? My other postulate is, namely, that the imminent need of leaping power, with the resulting physical exertions that obtain at a stream barrier, call into being the formation of a higher corpuscle content in the blood. Obviously this would have the effect of imparting to the blood an increased oxygen-carrying coefficient. Surely, the burden of proof falls *on those* who make the claim that piscean activity does not respond *to a changing supply of* available free oxygen.

In a recent paper by Gilbert and O'Malley[1] relative to salmon of the Yukon River they present a table designated to indicate the rate of travel of the spawning run up the Yukon River. Based on their data the first 279 miles up from the mouth was made at an average rate of 34.9 miles per day; the next 276 miles at 46 miles per day; the next 296 miles at 74 miles per day; the next 376 miles at 47 miles per day; and the remaining intervening 277 miles to Dawson at the average rate of 92.3 miles per day. With the exception of the 376-mile stretch, there was a very obvious increase in the rate of travel over the 1504 miles as the salmon progresses toward the headwaters of the Yukon. The final 277 miles (below Dawson) being covered at the fastest rate of the several legs of the journey. This phenomenon further substantiates the above presented theory of the influence of oxygenation upon the fluvial activities of mature salmon, since the Yukon no doubt, like other streams, is more broken and interrupted in the upper reaches.[2]

We will refrain from using a formal summary and merely recapitulate to the extent of stating that a careful investigation of the Redding dam—covering a period of over three weeks—has positively established the fact that said dam (as it was during our observations) constitutes an almost perfect barrier against the upstream migration of salmon to their natural spawning beds. Careful computation indicates that, during the period from September 14 to October 7, 1921, inclusive, 99.53 per cent of the salmon which arrive at the foot of the dam are unable to pass it, and are thus denied the possibility of propagating their kind.

Whether it is possible that a portion of this barred horde may persist below the dam until the flashboards are removed at the close of the irrigation season, is not established. However, between fishermen, mechanical injury at the dam, precocious spawning, infectious diseases and other inimical agencies, the mortality is shockingly severe.

The officials of the Anderson-Cottonwood Irrigation District probably took the position that the matter of serving their patrons with irrigation water is of more vital concern than is the migration of salmon which supplies the upper Sacramento system. Fortunately, in the case of a river obstruction of the height of the Redding dam, the construction of a practicable fishway is not a difficult matter. The Fish and Game Commission has prepared plans for such a fishway and the commission intends to see that adequate provisions are installed at an early date in order that the salmon run may become reestablished as it has been since time immemorial.

[1]Investigation of the Salmon Fisheries of the Yukon River, U. S. Bureau of Fisheries, Document No. 909a.

[2]In the published works of Wells, Shelford, Allee and others on the reaction of fishes to various concentrations of oxygen and carbon dioxide, it develops that the oxygen content varies from 1 to 15 c.c. per liter and the carbon dioxide from —7 c.c. to 47.8 c.c. per liter under diverse natural conditions. Wells states that "the lower end of a 50-foot pool in a small creek may contain 5 c.c. per liter of oxygen less than the water of the upper end." These workers also have shown that fishes often react in behavior to an oxygen concentration as high as between .7 and 1 c.c. per liter, and are even more susceptible to carbon dioxide. They show that oxygen in large amounts (10 c.c. per liter) combats the detrimental effect of high carbon dioxide (50 c.c. per liter).

RECORDS OF THE CAPTURE OF FUR SEALS ON LAND IN CALIFORNIA.

By Edwin C. Starks.

Of the many accounts of the taking of fur seals on land in California—especially on the outlying islands, none of them tells whether the seals were the Alaska fur seal, *Callorhinus alascanus,* or the Guadalupe Island fur seal, *Arctocephalus townsendi.* The reason for such neglect is that when most of the records were made it was not known that the Guadalupe fur seal was quite different from the Alaska fur seal.

Dr. C. Hart Merriam described the Guadalupe fur seal in 1897 from some weather-worn skulls picked up on the beach at Guadalupe Island by Dr. C. H. Townsend. Pictures of the type skull are here reproduced. Dr. Merriam wrote: "The species seems doomed to speedy extermination, and, so far as known, no museum in the world has a single specimen." Only 15 or 20 years before that time there were thousands of fur seals on Guadalupe Island, but within a space of a very few years sealers had almost completely exterminated them. One or two expeditions have since attempted to obtain specimens, and though a very few have been seen none has been secured. This island appears to have been the scene of the last stand of this species of fur seal, which was probably the species that was at one time abundant on the outlying islands of our coast.

The Alaska fur seal migrates every year from its breeding ground on the Pribilof Islands in Bering Sea southward to some point off the California coast. This point is variously stated from "off the coast of northern California" to "the latitude of southern California." With the exception given below of the Alaska fur seal, that was found on the Oregon coast, there is no evidence that they ever come to land.

Now all of the animals of this group have habits that are as nearly unchanging as habits conceivably can be, and we can feel reasonably sure that if the Alaska fur seals ever had the habit of landing during their migration they would still do so. On the other hand, the fact that the Guadalupe fur seal is practically extinct is an irrefutable reason to explain the present absence of that animal on our coast, where once it may have been abundant. What fur seal was found on the Farallones, is perhaps more problematical than what seal was found on the Santa Barbara Islands, which are more nearly in the same faunal zone as Guadalupe Island.

Dr. C. H. Townsend (Rept. Fur Seal Invest. 1896–7. Vol. III, p. 268) says: "From the history of the smaller seal rookeries of the Pacific Ocean, it would seem that the fur seal could not be driven away to new islands, but stupidly lingers about its ancient haunts until extermination overtakes it." Though the Farallones may not have been a rookery (breeding place), they still were an "ancient haunt" of some form of fur seal. If the above trait can be relied upon it seems to indicate that the seal that inhabited them was the exterminated species, in other words, the Guadalupe fur seal.

On the other hand, perhaps the only record that we have of the landing on our coast of a fur seal of which the species is definitely known, is of an immature male Alaska fur seal that came ashore on

the Oregon coast, as recently recorded by the Journal of Mammology (Nov., 1921). It, of course, may have been sick.

As recorded by Bancroft* (XIX Hist. Calif. II 1801 to 1824) William Gale, captain's clerk of the ship Albatross, in a voyage along the California coast in 1809 to 1812, gives many items in his journal as to sea otter and seal fishing. In July, 1810, Gale was left on the Farallone Islands with seven men. Here he found two other bands of men that had been left a short time before from other ships, apparently

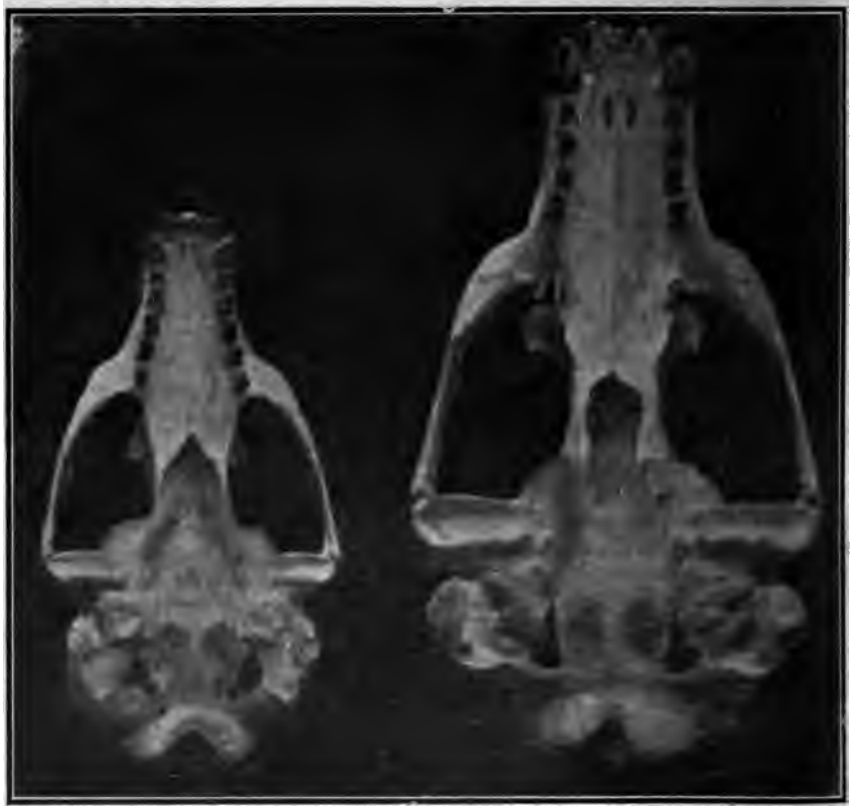

FIG. 67. Skulls of California (smaller) and Steller's sea lions. Note the wide space between the last molar tooth and the next one in Steller's sea lion. Both species have much longer muzzles than the fur seals.

of the same ownership and interests as the Albatross. By December, when the Farallone party was communicated with, they had taken 30,000 seal skins. In three years they took as follows:

1810, 33,740 skins; 1811, 21,153 skins; 1812, 18,509 skins; total for Farallones, 73,402 skins.

There is nothing in the report to indicate that these seals were not taken at sea, in which case they might have been of the Alaska migrating herd. But the time of the year at which they were taken would prove conclusively that they could not have been Alaska fur seals. It will be noted that Gale landed on the Farallones in July

*In a footnote Bancroft quotes that Capt. B. Smith with a party took 130,000 fur seals on the Farallones in two years, beginning 1808.

FIG. 68. Dorsal and ventral views of skull of Guadalupe fur seal. Photograph of type specimen in U. S. National Museum. (No. 83617.) Note the long narrow space between the rows of teeth and the short muzzle, as compared with the sea lions.

and by December had taken 30,000 skins. The Alaska fur seals appear off the coast about the middle of December. December 10 is the earliest date that one has been taken. Sealing at sea in California is continued through April, by which time the seals have got farther north. Gale took for the year 33,740 skins, so less than 4000 were taken after December, which would have been the only possible time the Alaska fur seal could have been obtained.

Bancroft further records (same volume, p. 633): "From 1812 to 1840 the Russians kept up an establishment at the Farallones as well as at Ross. The object at first was to secure fur seals, 1200 to 1500 skins being taken annually for five or six years, though Winship, Gale, Smith, and other Americans had taken the cream of this natural wealth a few years earlier. After 1818 the seals diminished rapidly until only 200 or 300 per year could be caught."

Sealing seems to have been resumed profitably in 1824. In G. Brown Goode's "Fisheries and Fishery Industries of the United States" (Sec. V. Vol. II, p. 357 footnote) is given a table of the number of fur seals taken on the Farallones for the years from 1824 to 1833. In the first year over a thousand were taken, but the number was less than 500 for the next year, and decreases gradually to 54 at the last year. The steady decrease of this and of the Gale operations is significant, for it would scarcely occur during this length of time if the record were of seals taken off the island in the open sea. In other words, shore sealing would probably indicate a local herd, while pelagic sealing would more probably have to do with the great migrating herd of Alaska fur seals from the north that could not be so easily or quickly depleted. The rapid recovery between each series of years of consecutive sealing could be explained, theoretically at least, to natural breeding. Without considering the natural forces of destruction, 100 females could increase in five years to 1600. Just what the natural loss would be if they were left undisturbed is problematical, of course. These figures are given only to show that the rapid increase is not too great to be explained by breeding only, though it was probably due to other causes as well, such as a migration from island to island.

In the same footnote is the statement that in 1878 a few hundred fur seals were taken by sea lion hunters on Santa Barbara and Guadalupe islands. The former locality is the only one of interest, for there is no doubt as to the seals of the other locality.

From "Life in California," by A. Robinson, published in 1846, but written from notes made from 1828 to about 1842, I copy this: "Finally we saw the rocks called the Farallones. We soon passed the largest and southermost one, which was still occupied by the Russians; and could distinctly perceive among the huts ten or twelve persons, who were living there for the purpose of catching fur seal, which were so abundant in former years, that my friend G——— assured me he had assisted in collecting during one season over 80,000 skins from this same island." Farther on in the book "friend G———" pointed out the place on the island where fur seals were clubbed. This was in 1833, and "many years had passed." The extravagant number stated, which far exceeds other records for the Farallones of

this date more or less invalidates this account. I quote it because it is the only one that indicates how and where the seals were taken, or that they were taken on land and not at sea.

From "Natural Wealth of California," by T. F. Cronise, published in 1868, I copy the following: "There is a species of fur seal (yet undetermined scientifically) which visits the Farallones, and other islands of our coast, in small numbers." The author recognizes the sea lion for he states that it is of little value.

Captain C. M. Scammon, in "Marine Mammals of the Northwestern Coast of North America," in 1874, writes: "On the coast of California, many beaches were found fronting gullies, where (fur) seals in large numbers formerly gathered; and as they there had plenty of ground to retreat upon, the sealers sometimes drove them far enough back to make sure of the whole herd, or that portion of them the skins of which were desirable."

Mr. Frank Stevens in his book on "California Mammals," says: "When California was first settled by the whites, fur seals were occasionally found on some of the islands, and at a few localities on the mainland, but whether these were of this (Alaska fur seal) or of the following species (Guadalupe fur seal) is not now known."

Dr. C. H. Townsend, in "Report of Fur Seal Investigations" (1896–1897, Vol. III, p. 268) in referring to Guadalupe fur seal says: "It is reported that five seals were taken on Richardson's Rock, off San Miguel Island, one of the Santa Barbara group, in 1890."

In 1902, when I was studying sea lions of Santa Cruz Island, I was told by Capt. Roselyn Vasquez, a man who had considerable experience as a sealer in Alaska, and in capturing sea lions for zoological gardens, that the year before three fur seals had been killed on the island. This was later repeated to me by a man in Santa Barbara, where, if I remember correctly, the skins were sold.

Dr. Gray received at the British Museum from Monterey in 1859 the skin of a fur seal. Dr. Allen (North American Pinnipeds) naturally referred this to the Alaska fur seal, the Guadalupe seal not having been described at that time. Which of these two forms it is remains unknown, and probably will remain unknown until the differences between them in pelage are better known. The skull that accompanied the skin did not belong to it.

Recently I was told by Mr. Michael Noon of Monterey, who had spent years of his early life at various of the California shore whaling stations, that once he had seen a considerable band of fur seals that had landed in a little bight at Monterey near the old custom house.

Just as I have finished this paper I receive from Mr. A. W. Anthony, Director of the Museum of the San Diego Society of Natural History, a letter dated April 15, 1922, telling me of the latest capture of a Guadalupe fur seal on our shores. It is a two-year-old female, captured alive, and has been placed in the San Diego Zoological Garden where it is doing well.

On the whole, the weight of evidence seems to point to the conclusion that of the seals that have been taken on our coast, when taken on land were the Guadalupe fur seal (*Arctocephalus townsendi*).

1. The present absence of the fur seals on the islands is accounted for if they were of the Guadalupe species, which is not the case if they were of the Alaska species.

2. The time of the year that some of the seals were taken on or about the Farallones proves that they, at least, could not have been Alaska fur seals.

3. The evidence of the rapid falling off of the catch in each of the records we have of sealing during consecutive years makes it probable that it was not the great Alaska fur seal herd that was drawn from.

It is hoped that steps may be taken looking towards the absolute protection of this seal, if any still exist on Guadalupe Island, which is probable, together with the small remaining band of elephant seals of the same locality.

The pictures here published of the skull of *Arctocephalus townsendi* (type) were kindly furnished by the United States Biological Survey through the interest of Dr. C. Hart Merriam. It is hoped that anyone finding such a skull on any of the outlying islands will send it to the California Fish and Game Commission at San Francisco. A skull from the Farallones would be particularly valuable. In this way we could learn whether the skull was of the Alaska or of the Guadalupe fur seal; obviously very desirable information. There is danger of mistaking the California sea lion for the fur seal. To show the differences photographs of the skulls of the sea lions are here published. Note that they have much longer muzzles and that the rows of teeth are not nearly so close together.

OBSERVATIONS ON THE EGG YIELD OF KLAMATH RIVER KING SALMON.

By E. A. McGregor.

In 1921 Professor J. O. Snyder published a short note in California Fish and Game entitled "How Many Eggs Does a Salmon Lay?" His conclusions were based on a series of 30 king salmon from the Klamath River. He found that the number of eggs per female varied from 2146 to 4812—a range of 2696, with an average of 3572. Professor Snyder called attention to the fact that the size and egg-content of the right and left ovary usually differ somewhat, and that in his series the left ovary was more often the larger. He further concluded that no very definite relation was to be seen between size, weight, or age and the number of eggs.

The present writer, at the suggestion of Professor Snyder, has recently conducted a similar examination of the ovaries of 68 king salmon from the Klamath River. The method of computing the number of ova was the same as that used by Snyder. It consisted of carefully weighing the ovaries, counting the number of ova per 10 grams, and then calculating the total number. The method was found to be accurate within about one per cent.

It is of interest to note that the author's series presents a somewh different composition from that of Snyder's. Our ova c Table I) varied from 2013 to 8406, or a range of 6393 and

TABLE I.—Analysis of 68 King Salmon Females With Reference to Length, Age and Ovary Characteristics.

Fish number	Date, 1921	Weight, left ovary, grams	Weight, right ovary, grams	Eggs in left ovary	Eggs in right ovary	Total eggs	Length of fish, cm.	Age of fish
1	8-15	110.4	120.4	966	1,047	2,013	92	5
2	8-27	50.5	49.7	1,164	1,307	2,471	65	3
3	8-12	35.3	29.4	1,331	1,170	2,501	61	3
4	9-2	77.8	75.5	1,291	1,310	2,601	66	4
5	8-15	40.2	41.1	1,333	1,299	2,632	68	4
6	8-16	181.5	181.5	1,316	1,379	2,695	85	6
7	8-31	66.8	62.9	1,336	1,352	2,738	73	4
8	8-24	110.6	115.1	1,355	1,468	2,823	70	4
9	8-16	57.2	54.4	1,499	1,474	2,973	68	3
10*	----------	96.2	98.0	1,477	1,558	3,035	----------	----------
11	8-22	89.1	86.0	1,550	1,496	3,046	71	4
12	9-6	144.5	144.2	1,546	1,500	3,046	81	5
13	8-24	120.2	107.5	1,581	1,489	3,070	76	4
14	8-20	90.5	99.4	1,425	1,650	3,075	77	4
15	8-24	191.6	203.4	1,494	1,607	3,101	80	4
16	9-1	60.6	58.0	1,576	1,563	3,139	70	4
17	8-31	179.1	171.8	1,594	1,581	3,175	84	5
18	8-19	104.0	94.9	1,591	1,590	3,181	69	4
19	8-12	237.0	220.0	1,647	1,609	3,256	88	5
20	9-2	146.0	147.2	1,599	1,678	3,277	100	6
21	8-27	114.1	123.2	1,573	1,725	3,298	74	4
22	8-19	205.9	211.0	1,647	1,656	3,303	86	4
23	8-18	36.3	32.7	1,670	1,635	3,305	66	4
24	8-4	89.0	86.2	1,718	1,629	3,347	77	5
25	8-26	70.1	70.5	1,675	1,685	3,360	71	4
26	8-16	83.5	85.5	1,620	1,753	3,373	73	4
27	9-5	134.8	124.0	1,739	1,674	3,413	71	4
28	9-3	158.6	162.7	1,697	1,749	3,446	88	5
29	8-31	175.6	223.6	1,730	1,756	3,486	91	5
30	8-25	200.9	197.2	1,766	1,755	3,523	82	4
31	8-18	214.0	192.0	1,819	1,718	3,537	75	4
32	8-31	173.4	177.5	1,734	1,819	3,553	78	4
33	8-24	301.4	300.0	1,808	1,785	3,593	86	4
34	8-15	146.4	147.3	1,779	1,834	3,613	81	5
35	8-25	221.9	217.2	1,864	1,759	3,623	88	5
36	8-20	55.0	53.7	1,837	1,788	3,625	70	4
37	8-12	51.0	53.4	1,749	1,896	3,645	68	4
38	8-26	158.2	198.9	1,661	2,046	3,707	84	4
39	9-2	211.0	164.0	2,078	1,665	3,743	87	5
40	9-1	140.4	121.3	1,966	1,935	3,901	81	4
41	9-13	191.4	199.8	1,847	2,058	3,905	86	6
42	8-27	202.5	192.0	1,954	1,978	3,932	81	4
43	8-24	267.2	245.1	2,031	1,912	3,953	90	5
44	8-19	298.2	302.4	1,938	2,056	3,994	93	5
45*	----------	58.0	51.0	2,625	1,436	4,061	----------	----------
46	9-5	148.6	158.0	2,170	1,980	4,150	80	5
47	8-26	156.4	158.9	2,018	2,137	4,155	86	5
48	8-16	215.7	219.5	2,017	2,151	4,168	86	4
49	8-19	185.3	184.7	2,066	2,124	4,190	79	4
50	8-18	300.9	293.0	2,151	2,154	4,305	91	5
51	8-1	254.3	242.3	2,250	2,072	4,322	69	4
52	9-16	179.9	179.9	2,204	2,195	4,399	94	5
53	8-9	309.7	323.0	2,152	2,277	4,429	91	5
54*	----------	273.4	261.2	2,297	2,155	4,452	----------	----------
55	8-15	283.2	301.3	2,286	2,320	4,586	89	5
56	9-1	186.6	195.8	2,174	2,438	4,612	95	6
57	8-27	248.0	252.0	2,306	2,344	4,650	90	5
58	8-26	217.2	212.9	2,367	2,299	4,666	92	5
59	8-22	386.8	355.5	2,417	2,275	4,692	92	5
60	8-20	241.0	294.6	2,121	2,592	4,713	92	5
61	8-25	218.0	265.6	2,125	2,603	4,728	93	5
62	9-3	471.8	454.6	2,477	2,682	5,159	100	6
63	8-9	257.0	277.2	2,621	3,035	5,656	91	5
64	9-6	270.6	306.4	2,625	3,033	5,658	105	5
65	9-3	379.0	370.3	2,994	2,981	5,975	107	6
66	9-2	115.5	102.2	3,407	3,061	6,468	79	4
67	9-5	311.2	338.6	3,781	4,165	7,946	95	5
68	9-1	832.5	515.5	3,225	5,181	8,406	105	5
Averages	----------	177.89	181.49	1,919	1,972	3,891	----------	----------

*Tag number lost.

3891 ova per fish. From the table it will be seen that 37 fish had more ova in the right ovary while 31 fish had more ova in the left ovary, which condition is just the reverse of that in the case of Snyder's series. This strongly suggests that the ovary of one side is just as likely to exceed in size and number of ova as that of the other side.

Figure 69 represents a frequency chart which combines the egg counts of Snyder's series with those of ours (a total of 98 cases). The class interval is 200 eggs. The broken line forms the "curve" resulting from the plotting of the actual cases; the solid line has been derived from the former by the process of "smoothing by threes."

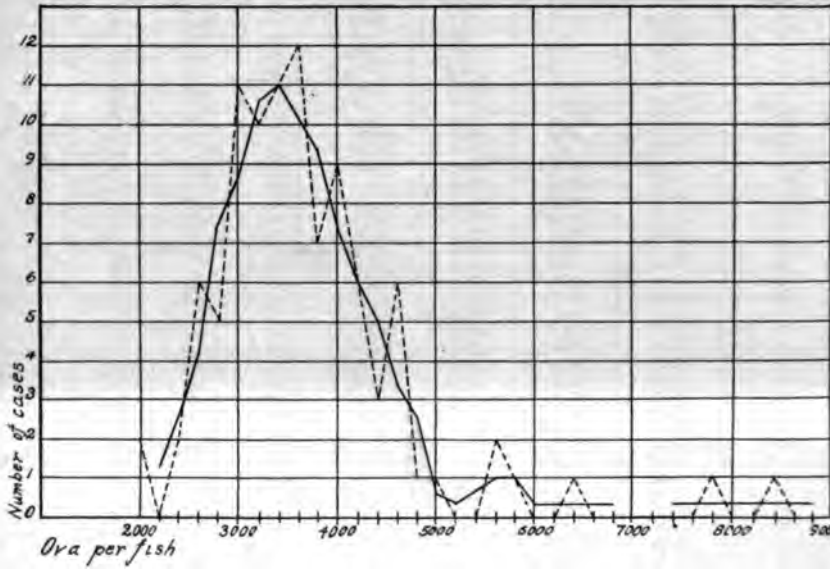

FIG. 69. Graph showing case distribution of the total egg counts of 98 king salmon from the Klamath River.

In the parlance of the statistician, figure 1 constitutes a very satisfactory frequency curve; that is, the great mass of the cases are dispersed rather symmetrically in regard to the mode. The mode is seen to occur at class interval 3400 to 3600 and does not coincide with the weighted average owing to a considerable skewness of the curve on the upper side, caused by a very few exceptional cases.

In figure 70 we present a graph again combining all of Snyder's cases with those of ours. A correlation is shown to exist between "length of fish" and "number of eggs." Each dot on the graph represents a case—98 in all. The continuous portion of the "curve" was derived from the case distribution by the process of twice "smoothing by threes." Beyond either extremity the "curve" is continued by a dotted line which connects with the most remote cases of the series.

It will be seen at once that a rather obvious "trend" exists. We believe that, were we in a position to plot the data from a [illegible] series, the resulting "curve" would approximate a straight line connecting the lower left hand extremes with the upper right hand extremes.

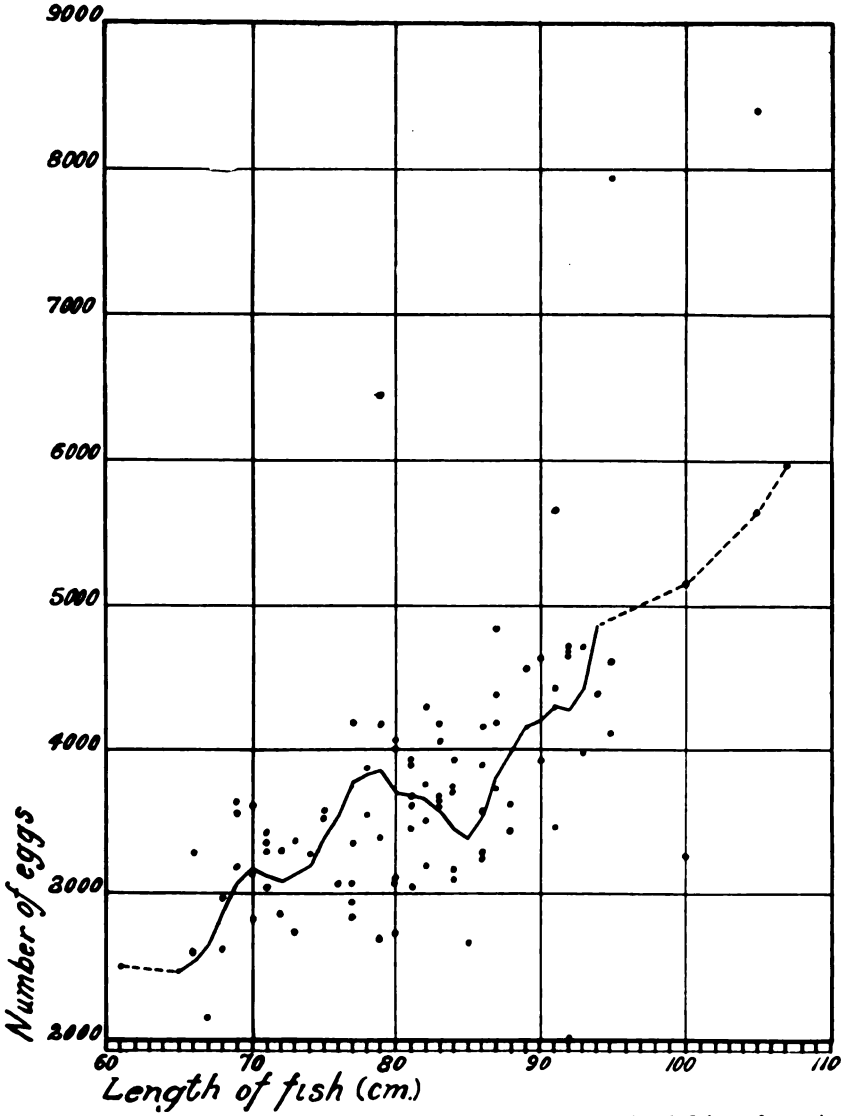

FIG. 70. Graphic representation of the relation between length of fish and number of eggs in the case of 98 king salmon from the Klamath River.

There are four or five cases which do not conform nicely with the mass distribution of the series. For example, one fish 105 cm. long possessed 8406 ova; another 95 cm. long had 7946 ova; while still another 92 cm. long had the fewest ova of any fish of the series—2013. Concerning these aberrant cases, all we can offer by way of explanation is that it is barely possible that these fishes belong to a race or races of salmon alien to the Klamath River or to unusual races native to the Klamath River. If the former hypothesis be true they may be either "stragglers" or fish that have become established through the transplantation to the Klamath system of eggs from other streams.

TABLE II.—Ninety-four Klamath River King Salmon, Tabulated to Show Relation Between Age and Number of Eggs.

Number of eggs (Class interval is 500 eggs)	Number of fish of different ages			
	3 years	4 years	5 years	6 years
2,000 to 2,500	1	1	1	
2,500 to 3,000	2	9		1
3,000 to 3,500		18	6	1
3,500 to 4,000		17	6	1
4,000 to 4,500		7	8	
4,500 to 5,000			7	1
5,000 to 5,500				1
5,500 to 6,000			2	1
6,000 to 6,500		1		
6,500 to 7,000				
7,000 to 7,500				
7,500 to 8,000			1	
8,000 to 8,500			1	
Totals	3	53	32	6
Mean	2,583	3,495	4,344	4,250

Table II is designed to present the data from 94 Klamath River salmon in such a way as to exhibit any possible relation between the age of the fish at maturity and the number of eggs. Such a correlation is actually seen to exist. The mean egg count for the three-year fish is 2583 ova; for the four-year fish, 3495 ova; for the five-year fish, 4344 ova; for the six-year fish, 4250 ova. Only six fish fall in the six-year group, and it is likely that a similar analysis of a much larger series of salmon would reveal that the average number of ova for the six-year salmon exceeds that of the five-year fishes.

Some years ago Mr. N. B. Scofield expressed himself as of the opinion that there is a considerable difference in the number of ova per fish as between the Sacramento River and Klamath River salmon. In 1902 Cloudsley Rutter of the United States Fish Comimssion[1] made the statement that "the average (Sacramento River king) salmon produces about 6000 ova." Mr. W. H. Rich, of the United States Bureau of Fisheries, informs us that the records of the Battle Creek Hatchery, together with his independent observations, indicate that the Sacramento salmon yield an average of about 6000 ova per female. Mr. Scofield's opinion seems to have been substantiated.

Such a study as that embraced in the present paper has both a zoological and an economic bearing. From the former standpoint it is patent that a careful diagnosis of a considerable series of individuals, with reference to such a fundamental biologic feature as the number of ova, is certain to be usable at some future time in matters where specific and racial relations are concerned. The most obvious economic application of our data lies in the contribution toward a knowledge of the relative prolificacy of the various races of salmon. Such a knowledge will have a very direct bearing on the operations of egg taking and spawning. By exercising a selective choice as between salmon races, it is not unreasonable to suppose that much good may thereby result in propagation practices.

It is to be hoped that the present study may be followed by others of a similar nature with reference to the Sacramento and possibly other salmon runs.

[1]Popular Science Monthly, July, 1902.

THE FISHERIES OF CALIFORNIA AND THEIR CARE.

By Will F. Thompson.*

The scientific investigations necessary for the care of the fisheries of California can not be understood nor formulated without some knowledge of the condition of these fisheries and their relation to those of other regions where investigations have been carried on. The brief presentation of the difficult material will, it is hoped, arouse interest in the really important problems to be faced.

The fisheries of California are recent in origin—that is understood by everyone as a natural result of the recent settlement of the State. But just how recent they are as really great fisheries, and how in that respect they correspond to the other great fisheries of supposedly much greater age, is very little known. They are in reality the result of normal influences acting throughout the world, although to the dealer or the fisherman their origin may seem connected with such phenomena as war or the depletion of other fisheries such as salmon. Whatever the specific causes of their beginning, there can not be much doubt but that a place existed for them, or they could not have arisen to their present height.

The progress of exploitation of our fisheries has been slow and steady until recently. In 1880, at the time Dr. Jordan made his survey of our coast fisheries, they existed, as he said, mostly as possibilities. Other surveys were made in subsequent years, as 1889 to 1892, 1904 and 1908, and some growth was noted. Then in 1915 the Bureau of Fisheries figures indicated a great rate of increase. And since 1915 the annual summaries of the California Fish and Game Commission have shown, on the whole, a surprising enlargement, especially of the total used for canning. (Fig. 71.)

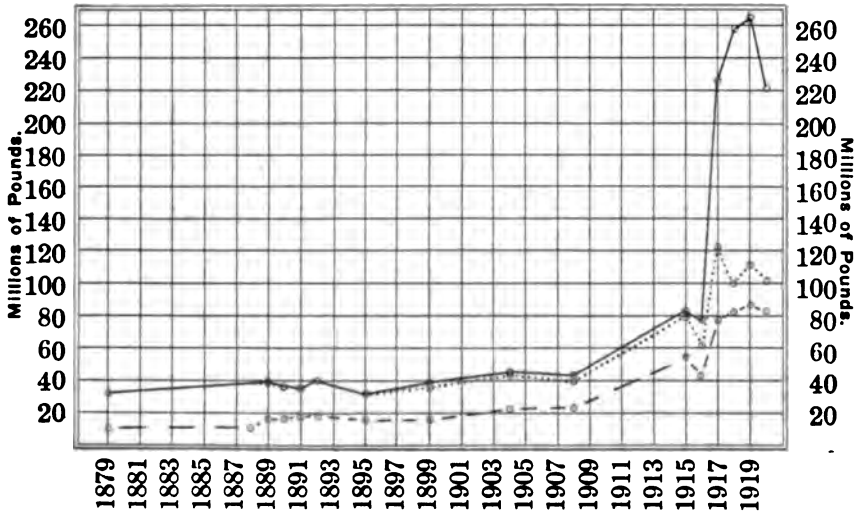

Figure 71. Growth of California Fisheries.

——— All marine fishery products except Alaska cod and oysters.
. . . . . Same, less sardine.
- - - - - Fish only, less salmon, cod and shad as well as sardine.

*A report made to the Committee on Conservation of Marine Life of the American Association for the Advancement of Science. The assistance of Frances N. Clark in the collection and preparation of data used in this report is gratefully acknowledged.

Not merely does the grand total show a rise, but those for the individual species have climbed steadily. Attention should be called, for instance, to the barracuda, the consumption of which can not even remotely be called of war origin or temporary in nature. Vastly greater amounts have been used in the more recent years, as is shown by the accompanying chart. (Fig. 72.)

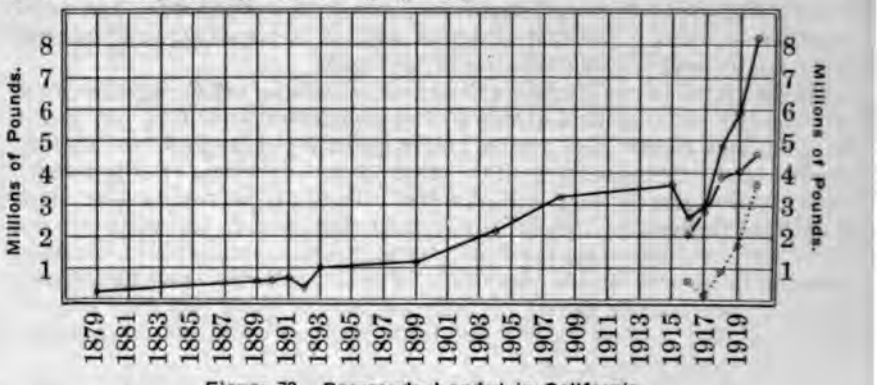

Figure 72. Barracuda Landed in California.

——— Total landings.
- - - - - From California waters.
. . . . . From Mexican waters.

But aside from this general increase, other things have been happening in California waters. One of these is the steadily falling importance which the mollusk and crustacean fisheries show, contrasting with the rise in the catch of the marine fishes. The exploitation of the mollusks, such as the abalone for jewelry, and the shrimp for fertilizer in China, were what one might call freak fisheries, for easily obtained products, to satisfy a demand that already existed—one to small extent only dependent upon the population of our country or its transportation facilities. These fisheries shortly reached their

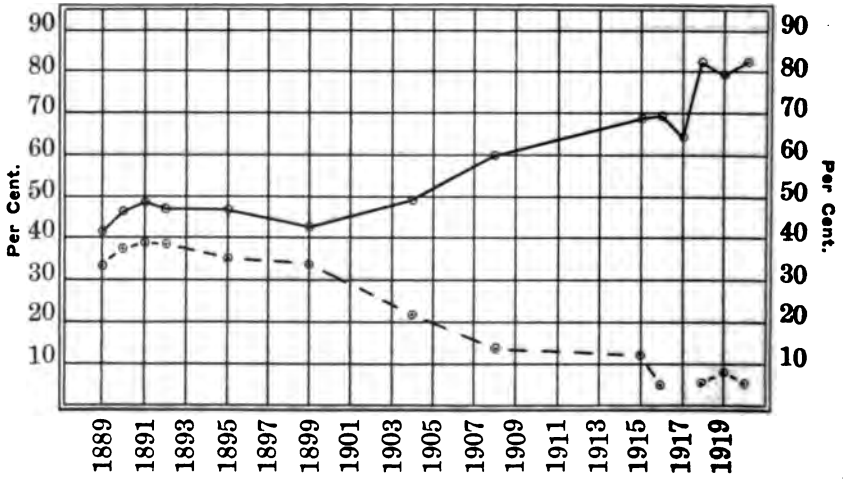

Figure 73. The Percentage Certain Categories Form of all Marine Products, Except Alaska Cod and Oysters, Landed in Californ
--- Fish, less salmon and shad.
- Crustaceans and mollusks.

climax, and have recently sunk both absolutely and relatively to minor importance as compared to the fishes used for food. The phenomenon is one indicating the maturity, in a certain sense, of our fisheries, when the great and growing demand for foods asserts its rightful place over the incidental demands which have run on before. (Fig. 73.)

Another phenomenon to which it will be well to call attention is the fact of the actual failure of our own waters to produce a sufficiency. The spiny lobster is an instance of this, as the accompanying graph will show. Since in the early statistics it is impossible to separate lobsters of Mexican origin from the relatively very few landed in San Diego from California waters, one category has been formed of Mexican plus San Diego lobsters and contrasted with those from other counties of the State. The invasion of Mexican waters is well illustrated. Another instance of the same is the barracuda, likewise shown in a graph. The demand for these fish is being satisfied to an increasing extent from Mexican waters, although here the adequacy of the available statistics may well be questioned. The fact, however, is clear, that a process which has occurred in other older fisheries has begun here, namely the outgrowth of the domestic supply by the demand, so that fishing grounds farther away are being used. It will be interesting to see how far the process, which in Europe carries fishermen to the Barents Sea and to tropical Africa, can and will go. It very probably will be found to accompany over-fishing of our own grounds, as it has in European waters.

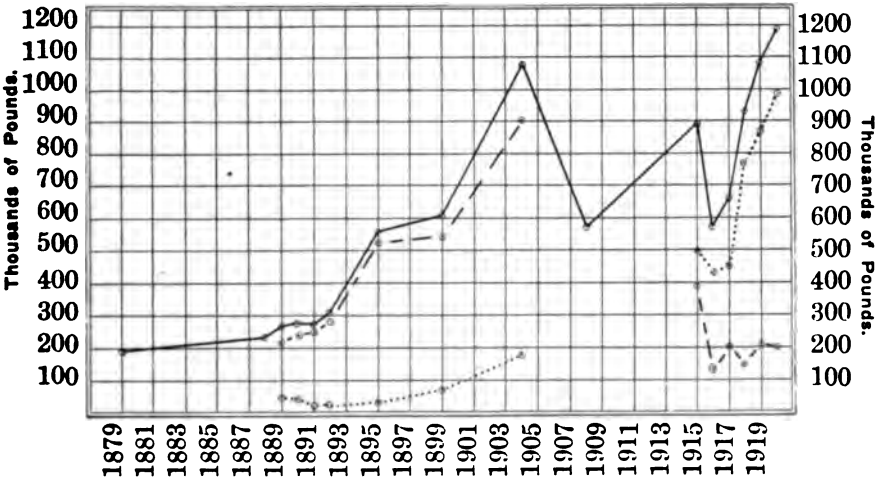

Figure 74. Spiny Lobsters Landed in California.

——— Landed at all ports.
. . . . . Landed San Diego and Mexico.
- - - - - Landed other California ports.

It seems, from what has been presented that our fisheries are of not merely recent, but very recent origin. In certain individual cases, there seems not to have been time yet for over-fishing to have shown its effects. The young born while the fishery for barracuda was still small have barely come to full maturity. Their abundance, therefore, can not have become very seriously affected yet. But the question is not what

has happened but what will happen. That the future is more than doubtful can be demonstrated.

If trouble were afar, and it were possible safely to say, "Let us overcome that problem when we get to it," this report would not carry much weight for the ordinary man. But there is every reason to believe that the problem is near at hand. Our fisheries have advanced farther than we have perhaps dreamed. Indeed, in the flush of their youth and the existence of a rich accumulated reserve, they have perhaps gone too far. The biologist should be in a position to eliminate that *perhaps*, and to put either *not*, or *certainly* in its place. It is a tribute to the slight interest that is taken in practical biology that not even an attempt has been made.

How far have our marine fisheries really gone? For answer we might make a comparison with such fisheries as those of Europe. They are popularly believed to be the most ancient and most extensively exploited of any, but a comparison is difficult, as we shall see. Should we compare our fisheries in California with those of a restricted area like that of the North Sea, or with those of all the seas to which European vessels go? Should the basis be the area of the coastal banks within the 200-metre line which is commonly accepted as limiting most great fisheries? Or should it be the length of coast line because the vast body of the ocean determines the abundance of the fish? Pelagic species might be compared on a basis of coast line, demersal on a basis of fishing banks, but demersal species are dependent upon pelagic animals, and pelagic animals in good part upon the coastal waters. Certainly the truth seems to be somewhere between the results obtained by comparison of length of coast line and area of fishing banks.

To obtain some basis for comparison, let us for the time being adopt the conclusion generally held sound, that all great fisheries are very largely limited by the extent of the coastal waters and the area of the banks within the two hundred metre line. The albacore ranges well beyond that, as indeed the sardine does, but that does not necessarily invalidate the applicability of the rule, which certainly seems to hold for demersal or semidemersal fishes.

The North Sea is for the greatest part within the two hundred metre line and has an area of 152,500 square miles (geographic) according to the International Council for the Investigation of the Sea (whose data will be used unless otherwise stated). The crest of this production was reached for the time being, in 1913, just before the great war, and it will be legitimate to compare that with our maximum year in California, 1919. The catch in our waters was about 125,000 tons, in those of the North Sea 1,408,000, a ratio of one to eleven. But the area within two hundred metres is, off the whole coast of California, but about 7500 square miles, in the proportion of one to twenty to that of the North Sea. In other words our waters seem to be producing nearly twice the amount per square mile.

If the seas of the Atlantic coast of Europe, with the Baltic, Barents Sea, the White Sea, and the Moroccan Coast included, minus the ar within the three-mile international limit, are considered, a tota about 700,000 square miles is found (Board of Agriculture and I eries for England, 1906). The total yield in 1913 was 3,077,000 The ratio between the California area and the above area is

ninety-three, of the catches one to twenty-five. Hence three and seven-tenths as much per square mile is taken from our waters.

The question then arises as to whether the fisheries are really comparable, and as to the relative part the pelagic fishes play in the total. One may compare the herring, the sprat and its allies in Europe with our sardine and herring, and find that 64.4 per cent of the catches in our waters are composed of these species, as contrasted with 67.1 per cent in the North Sea, and 45.2 per cent in all Northwestern Europe. It would seem clear from the comparisons that our use of the herring-like pelagic fishes is extensive, but not much more so than that made in European seas.

In so far as the remaining species are concerned, the cods take the place of our mackerel-like fishes if to our mackerels are added the larger round predaceous fishes such as the barracuda and the salmon. The following table illustrates this:

	North Sea	European Seas	California
	Per cent	Per cent	Per cent
Flatfishes	5.9	4.7	3.7
Herring-like fishes	67.1	45.2	64.4
Cods	21.5	39.8	
Large round fish			10.7
Rockcods			2.1
Mackerel-like fishes	1.9	2.4	17.4
Sharks	.9	1.2	.4
Small fish	1.0	1.8	.9
Miscellaneous, unclassified	1.8	5.0	.4
Totals	100.1	100.1	100.0

The compositions of the catches in the two areas do not vary widely in their essentials, and the relative intensity of fishing holds as much in the comparison of the minor groups as it does for the entire. Thus in the case of the flatfishes, the most typically demersal, the percentages do not vary widely enough between the areas to change the conclusion as to relative intensity deduced from the comparison of the entire fisheries.

The comparison might justifiably be ended here, if it were not possible that the use of such areas as a basis is an error. And, indeed, if the length of coast line of Atlantic Europe is used as a basis for comparison, the proportion of coast line (including the Baltic with its large herring fisheries) is roughly one to fourteen, as contrasted with that of the catch of one to twenty-five. Yet such a comparison errs at least as far in the other direction as does the use of areas, for it is very widely accepted that the North Sea is a very important part of the whole and that it owes its importance to its most remarkable area of shallow water banks, seemingly highly suitable for the production of the cods and flatfishes.

A more valid objection to the comparison of areas is the fact that in California the so-called pelagic fishes bear more of the burden than in Europe. To meet this a comparison may be instituted between the catches of pelagic fishes such as the mackerel and tuna, the sardines and herrings. There may then justifiably be added the albacore and tuna fishes—as representing the mackerels—to the sardine, and very probably the salmon fisheries are also properly pelagic. The "pelagic" fisheries then become as two is to twenty-seven, as contrasted with coast

lines of two to twenty-eight (very approximate). In other words the pelagic catch is nearly the same per mile of coast line.

Such exactness in comparison is very obviously not justifiable, as any biologist will see numerous objections and limitations to it. Prominent among these is the probable difference in productivity of the oceanic waters. But the point must be apparent that our fisheries, to be comparable at all, must have reached a high degree of development. And they probably are at present yielding more than the North Sea fisheries in proportion. What is the significance of such a fact, and where its danger?

The danger is for the most part in ignorance and lack of foresight. Our fisheries are steadily increasing. They will continue to increase just as fast as our population does, and every perfection of transportation, of preservation, or of marketing will add to that population increasingly large numbers from the inland peoples. The building of great cities with their dependence upon imported produce, and the industrializing of whole nations will enlarge the proportion of people dependent upon such sources of food as the sea. So the whole of modern civilization indicates increasing use of the resources of the ocean, and unless one lacks faith in the progress of the world, those resources must be conserved. The yield from the fishes can not be doubled every ten years and the limit not exceeded.

The sharp and recent rise in intensity of our fisheries is but a variation in the general rise taking place everywhere throughout the world. In the North Sea, where depletion is accepted as occurring and as proved at least in certain lines, the exploitation of the sea really began in 1880 or shortly thereafter, when steam first came to be used in vessels. Then in 1895 the otter trawl opened to the fishermen depths below fifty fathoms, and since then successive improvements have increased many times the efficiency of the gear used. The really great North Sea fisheries are in fact very recent, and those of the other seas of Europe still more recent. That depletion should come in this dawning of the era of exploitation is ominous to us, for there is no reason to suppose our fisheries immune from similar consequences.

There should not be any doubt in the minds of reasonable men that the North Sea has been exploited to its limit, and beyond in many respects. That is especially true of the plaice and the haddock. But there are two things concerning the North Sea and indeed all fisheries that need emphasis. One of these is the lack of data which indicate the condition of the fisheries previous to the last ten years. The other is the vast amount of labor now required to obtain a yield as compared to what is necessary in a virgin fishing area such as ours still is. This may be illustrated readily.

A pair of small steam tugs dragging a paranzella net with 50-foot spread catches off San Francisco an average of 6500 pounds per day, making two hauls of two hours each. But a modern steam trawler takes only 1700 pounds per day in the North Sea (Jenkins, The Sea Fisheries p. 158), not much over a fourth of the California catch, despite the far more efficient apparatus, and the practically continuous day and night fishing. It would seemingly be conservative to mate the abundance of fish in the North Sea as not a tenth wl on California grounds, in view of the differing efficienc- f th

It therefore seems justifiable to scientists far removed from the heat of the discussion to conclude that the North European Seas are really well along on the road to exhaustion while those of California are in comparison relatively unharmed, and a careful perusal of the existing data does nothing to shake such a conclusion. True enough, the evidence of depletion is in part unable to bear critical scrutiny, being highly complicated and defectively gathered. But the discovery that the existing evidence is faulty as regards many of the species investigated, provides no proof that over-fishing has not occurred, nor a lessening of the significant indications. On the contrary, it seems that depletion must be proceeding rapidly to provide even the proof that is obtainable in the welter of complications.

From such consideration as has been given of what has happened elsewhere during this world wide increase in intensity of fishing, it is possible to see where the danger lies for our California fisheries. Will they continue to grow without observation, and will there come a time when we will not know even remotely whether our fisheries are approaching exhaustion? That is exactly the state of affairs in Europe and may well be here.

Exhaustion does not necessarily become obvious to everyone when it occurs. The cost of catching fish is but a fraction of the cost of distribution. Thus the fisherman may receive eight cents per pound, where the retailer asks forty cents, and doubling the fisherman's price would add but a fifth to the retailer's price. The consumer is, moreover, willing to pay high prices for a product to which he has become accustomed, and the rarer it is the more he will pay. But there are, in addition, influences which actually counteract the effect of increasing scarcity in raising the initial cost. The accompaniments of that intensified exploitation which results in depletion are the constant broadening of the fishing grounds, the inclusion of more than one species of fish and of inferior quality in the catch of the boats, the development of means of preservation, the constant improvement of gear and the increase in quantity of apparatus. All these things tend to eliminate the great and sudden fluctuations in amount of yield which are characteristic of fisheries confined to one species or one locality. These variations in yield render the exploitation of the fisheries expensive and uncertain because the periods of abundance must be made to pay interest upon the capital and to maintain the organization during periods of scarcity. Their elimination as a result of intense fishing undoubtedly does reduce the cost of fish to the consumer, perhaps to the extent that for a while the influence of depletion in raising the initial cost will not be felt.

But in the end that very fact may defeat the natural safeguard which should protect a species, namely the lack of profit in carrying on a fishery when it comes dangerously near to exhaustion. It becomes possible to prolong a fishery because other species are taken; the by-product becomes the mainstay of the business and the depleted species is kept under a strain for which it could not itself pay. If it were not for cod, perhaps the halibut fishery of Iceland might have long since collapsed; and if it were not for the cheaper round fishes, the flat fishes in the North Sea might be pursued far less rigorously. On the Pacific Coast, the tuna and sardine fishery of California may have been of considerable assistance to the albacore fishery. In fact, the objection often raised to the possibility of over-fishing, that the fisheries

are prospering and that they would immediately cease to prosper should depletion in any one species occur, is not a valid one. But that they would ultimately fail as a result of over-fishing seems sure.

We have seen that our fisheries have recently undergone a very marked development paralleling that occurring elsewhere in the world, that their intensity equals or exceeds that in older over-fished areas, and that there is every reason to anticipate over-fishing here. In addition we have seen that it is necessary to keep data which will prove the condition of the fisheries. What the nature of that data is can be stated confidently from the experience of those men who have investigated the North Sea.

NATURE OF DATA NECESSARY.

Although the nature of the data necessary can be stated confidently, it is not easy briefly to define their extent and their complexity.

The primary requirement is knowledge as to the relative abundance from time to time of the fishes concerned. The actual abundance is out of reach of ascertainment, but an index to the changes therein is possible. And the first as well as the most ignored of the connected problems is the efficiency of the measures utilized. The taking of experimental catches by special apparatus has proved both expensive and futile and the general consensus of opinion is that the commercial catches furnish the best evidence.

But the commercial catches are the result of many factors, among which are the changing of gear with the years, the use of vessels of increasing efficiency, and the use of grounds farther afield. Such factors may be avoided by competent statistical methods.

In addition there are well pronounced meteorological and oceanographical influences affecting the catch and the fishes themselves, to an extent undreamed of by a person unacquainted with the fisheries. No avoidance of the effects of such is possible, save by the gathering of data over periods of time of sufficient length to allow the influences to counterbalance each other and reach a stable average. It is well known that successive years are more truly comparable through their averages than through identical months or days, because although the returns for the latter fluctuate widely, they tend to vary above and below, and around a mean. The study of how extensive the statistical records must be to present a true picture is one of the major problems which must be attacked.

After the solution, or the approximate solution of such problems, there remains the question of the significance of the actual changes in abundance discovered. In various fisheries there have been found great natural changes seemingly entirely unconnected with man's influences. So that one of the greatest problems to be faced is the distinction of such widespread variations and the effects of over-fishing. As Hjort has indicated in the case of the herring, and as we may find in our sardine, the spawning of a given year, say 1910, may provide the fish in the commercial catch for ten or twelve years, and the fishery p rise and fall in accordance with the growth and disappearance of class. A careful theoretical consideration of the possible cri the separation of such phenomena from the effects of over-fisl still to be made, and in addition, these criteria must be tested

But there is one fact acknowledged and capable of use in *aration, namely* that over-fishing diminishes the abundance of

fish, whereas during natural fluctuations a certain cycle of changes occurs. For the use of such a criterion a direct age assessment is necessary, or failing that a size assessment. That implies, both for the purposes of age or size assessment, and for the correlation of the discovered changes with physical and economic phenomena, an accurate knowledge of age and rate of growth. That is a purely biological problem of considerable difficulty, but it also involves a knowledge of annual migrations sufficient to assure the investigator that he is not drawing his material from varying sections of a population undergoing differential migration according to age.

The above are the essentials in the immediate care of the fisheries. There are omitted the investigations of such problems as the spawning periods, the existence of races according to locality, and similar facts which may be assigned as causes for various effects observed. The biologist can not omit them from his investigations, simply because of their utility in the formulation of theories and the explanation of facts, not so much because of their direct importance; but they should be assigned a purely secondary place in the work of preservation of our fisheries.

Finally, there are the problems connected with remedial legislation. These are mainly concerned with two things, one economic, the other biological. One is the existence of waste which may possibly be eliminated, to the benefit of the species, the other is the relative worth of protection to the various stages of the life of the fishes. Protection may be assigned at any stage for the actual purpose of reducing the catch, but the psychology of the public demands that some such ostensible reason as the capture of spawning or of immature fish be used. In so far as possible a really rational basis should be substituted for such totally unscientific ones, and this rational basis will seemingly demand a knowledge of rate of growth and of the death rate at various periods.

It will be seen from the above that the work to be done is of a more or less practical nature, interpreted from a background of biological and oceanographical knowledge. The more perfect this background the more perfect the practical results. So that it becomes a matter of first importance that the general biology of the fishes and the varying conditions in their environment be thoroughly investigated.

INVESTIGATIONS NECESSARY.

An indispensible basis for the study of our fisheries, both from the point of view of over-fishing and of the greater fluctuations which occur, is a system of statistics. It should be far more perfect than the ordinary compilations that masquerade as statistics, and should be collected by the biologist.

The first requisite of such a system is the provision of some measure of the relative abundance of the fishes concerned. The unit by which such abundance is measured must be a constant one, as far as possible, and it has been found that such units are difficult to find and variable according to the fishery. In the case of otter-trawls, the catch per hundred hours of fishing with a certain type of trawl; in the case of trawl lines, the catch per unit length of gear run; in the case of boats trolling for pelagic fishes, the catch per day of a given type of boat.

In other words a perfect statistical measure of abundance would depend upon the particular fishery investigated.

That, however, is plainly out of reach. Some less perfect measure, the error in which can be counteracted by the collection of sufficient data, must be substituted. In the case of our California fisheries, the same gears and vessels will in the long run tend to be fished to their full capacity to make them pay, or the variation in the way they are used will be relatively little from year to year. A careful record of boats, their gear and their catches is therefore reasonably good for the purpose of gauging the relative abundance of fish from year to year.

1. It is therefore proposed that the statistics to be gathered cover such details, and that the catches of the *individual* boats be compared from year to year to show the variation in yield. The comparison of individual boats is emphasized because it is obviously wrong to compare the catches of different boats. The changes in numbers of vessels, type of gear used, total catch, etc., and the market demand, should be incidental to this.

The method of collection of these statistics should be rendered as free from the personality of the collectors as possible. The completeness of the data obtained should rest neither upon the shrewdness nor the affability of the man in charge. It would be far better to have a uniform error year after year than a change from complete to incomplete as the personnel concerned change. In other words the collection of statistics should be systematized to act automatically and should be enforced by law. An illustration of the possibilities and feasibility of such a method is to be found in the present system of the California Fish and Game Commission.

It need hardly be necessary to point out the desirability of joint international action in the collection of such statistics. The United States-Mexican boundary line is conveniently placed for assisting in determining the points of origin of the catches.

Such a system of statistics may be made automatic, and its results filed away for reference.

2. The collection of special statistics should supplement this system and be applied to any fisheries threatened. An instance is to be found in the albacore fishery. In that there should be (*a*) a continuous record of the shifting locality of the fisheries, and (*b*) a series of measurements or age determinations throughout the season to determine the relative frequency of the age classes. One man could follow both the sardine and albacore fisheries, and perhaps the barracuda fishery from a given point, as San Pedro.

Such data should show the range of the fishery, and its expansion. Also the exhaustion of successive localities.

The age or size assessment should show the diminution in average size which is supposed to be an earmark of over-fishing. It has been much used, for instance, in the case of the Plaice fishery of Europe and has been found to hold for other fisheries, such as the halibut. From it also could be determined the presence or absence of fluctuations due to the relative success of the spawning seasons, a m[illegible] of great importance, as Hjort has shown in the case of the her[illegible]

3. The biology of the fishes concerned should be studied to supplement the above work. The most needed facts are

rate of growth, the migrations, and the causes of variations in abundance.

4. The first three divisions are those which are directly necessary for the care of our fisheries. But the adequate explanation of their fluctuations and an understanding of the more fundamental biological aspects of the fisheries undoubtedly depends upon a knowledge of the ocean, its currents, its contained life and the changes therein. The investigation of such facts should be carried on by those agencies not directly responsible for the observation of the condition of the fisheries, although certainly the latter should also aid where possible.

The specific investigations immediately necessary for the preservation of the California fisheries have been already undertaken by the State. It should be granted, under present conditions: (1) Support in the maintenance of its present program, and (2) representation in any organization designed to further the investigation and conservation of the fisheries, such as should be formed to bring into harmony the efforts of the various states, and the national government.

The more general investigations urgently needed for the enlightened and scientific care of the fisheries include the following: (1) The determination of the ova of our fishes, the period and direction of their drift; (2) the measurement of the amount of migration of our pelagic fishes, including a comparison from a racial or specific standpoint of the larger mackerels in California, Hawaii and Mexico; and (3) the recording of the oceanographical changes which may be correlated with the fluctuations in the abundance of fishes shown by the statistical and biological investigations. For these investigations ocean going vessels will be necessary, and their provision, as well as their program, must be determined by experts in conference.

In closing, it may be proper to summarize in a sentence what has been said. A science of vital statistics is proposed, and the basis for it must be governmental action founded upon biological knowledge.

APPENDIX.

DISCUSSION OF TABLE AND GRAPHS.

The statistics shown in the appended table are drawn from the reports of the United States Bureau of Fisheries until the year 1915 inclusive. It is highly regrettable that they are scattered and irregular in point of time although the general trend of the fisheries is illustrated. Moreover, their method of collection is not that which is recommended in this paper, and naturally the writer does not have any great faith in their freedom from error.

The data obtained for the years 1916 to 1920 inclusive are taken from the reports of the California Fish and Game Commission. With regard to these, it must be pointed out that the statistics for 1916 and 1917 were collected in a different manner and are much less dependable than those for the three later years. For example, to what extent the seeming fall in 1916 is due to defects in the method of collection, either of the United States Bureau of Fisheries in 1915 or the California Fish and Game Commission in 1916 and 1917, is now impossible

of ascertainment. It is therefore apparent that really accurate statistics are obtainable for but three years, including 1920. But the earlier data are surely sufficient to illustrate the general tendencies shown in the total catches of the various fisheries.

As the purpose of the table and graphs is to illustrate the tendencies of the native marine fisheries, various categories of returns ordinarily included are omitted. Thus the cod bought from Alaska is everywhere subtracted, as are the oysters because they are cultivated and imported as spat. The anadromous salmon and shad are omitted in some instances because the first have been the object of special long established river fisheries, and are aided by hatcheries, while the second species was transplanted from the Atlantic. Sardines packed in California showed very great changes due to war conditions, and their use may be regarded by some as not a part of the normal growth in our fisheries. In figure 1, provision has been made for those who prefer to ignore this fishery, and the increase in our fisheries is demonstrated without it.

It remains to call attention to the difficulty faced in distinguishing barracuda and spiny lobsters from Mexico. The figures obtained at present are probably much more nearly correct than those obtained previously. In fact no provision seems to have been made in the Bureau of Fisheries figures for Mexican importations. For that reason the spiny lobsters landed in San Diego have been all regarded as Mexican in origin, simply to emphasize the southward movement of the fishery. (Fig. 74.)

The treatment of these statistics summarizes practically all that is known concerning the increase of our California fisheries. It is exceedingly regrettable that the record is so imperfect and that it is confined to the total catch alone. No correlation of the changes with the great increase in the population of California since 1905 has been attempted, although the comparison is inviting and the connection between them seemingly intimate.

MARINE FISHERY PRODUCTS OF CALIFORNIA, 1879-1920.

	1879	1888	1889	1890
Marine fishery products, less cod and oysters	*31,249,020	----------	37,995,521	36,257,047
Sardines	900	5,140	1,097,397	1,314,800
Fish, less salmon, cod and shad	8,578,200	9,735,726	16,267,043	17,659,333
Mollusks and crustaceans, less oysters	6,661,100	11,609,755	12,415,769	13,136,565
Barracuda, including Mexican	200,000	----------	500,714	511,078
Spiny lobsters, including Mexican	190,000	**231,061	266,458	278,310

*Includes Alaska cod. **Doubtful.

	1891	1892	1895	1899
Marine fishery products, less cod and oysters	35,014,133	38,636,594	31,820,131	[illegible]
Sardines	937,568	752,904	732,293	
Fish, less salmon, cod and shad	17,512,927	18,567,258	15,258,543	
Mollusks and crustaceans, less oysters	13,095,216	14,634,809	10,953,895	
Barracuda, including Mexican	604,793	326,804	979,674	
Spiny lobsters, including Mexican	272,245	303,275	558,064	

	1904	1908	1915	1916
Marine fishery products, less cod and oysters	44,691,978	43,236,000	82,978,228	77,717,206
Sardines	1,036,470	4,639,000	4,859,106	15,402,578
Fish, less salmon, cod and shad	22,615,811	27,549,200	58,475,266	58,610,295
Mollusks and crustaceans, less oysters	9,370,098	5,267,000	9,823,987	3,228,269
Barracuda, including Mexican	2,159,282	3,205,000	3,592,646	2,589,653
Mexican barracuda				571,792
Spiny lobsters, including Mexican	1,078,065	573,000	892,392	572,536
Spiny lobsters from Mexico and San Diego				341,026

	1917	1918	1919	1920
Marine fishery products, less cod and oysters	225,910,101	257,909,441	264,744,525	220,729,600
Sardines	105,008,112	157,652,811	153,877,179	118,520,914
Fish, less salmon, cod and shad	183,444,843	240,569,110	241,227,824	202,775,842
Mollusks and crustaceans, less oysters	23,883,931	5,472,728	8,797,410	5,384,385
Barracuda, including Mexican	2,956,812	4,837,284	5,824,957	8,201,325
Mexican barracuda	165,115	951,593	1,786,105	3,615,947
Spiny lobsters, including Mexican	650,318	930,827	1,089,465	1,189,196
Spiny lobsters from Mexico and San Diego	255,444	735,077	832,571	942,020

THE CATTLEMAN'S RIGHTS.

By Roy. M. Hagen, Secretary California Cattlemen's Association.

The range cattlemen of the state are much disturbed over the annual loss of cattle due to the carelessness of deer hunters which seems to be increasing year by year. Not only are cattle actually killed and seriously wounded by careless hunters in the mountains, but perhaps even more serious than this is the manner in which cattle are driven from the range by the tremendous number of hunters who go into the hills and camp at water holes, depriving the cattle of necessary water and permitting their dogs to chase cattle to the extent that cattle are often driven from the high mountain ranges to lower elevations where poorer feed conditions exist, sometimes as much as six weeks before they normally would work to lower elevations. It has been conservatively estimated that this disturbing of cattle by hunters camping at water holes and by the use of dogs, causes a loss of between $2 and $3 per head annually.

There never was a question which did not have two sides with considerable logic and good reason on both sides. It is not the desire of the cattlemen to secure the passage of any laws which will unduly restrict the activities of hunters or vacationists in the mountains. The cattleman feels that the public has a right to these privileges, but he also stoutly maintains that he is entitled to consideration and that his property must be respected.

It is unfortunate that a comparatively small number of hunters cause most of this feeling on the part of the cattleman. It is undoubtedly true that the majority of hunters use discretion and a reasonable amount of common sense while in the mountains. It is the few who fail to respect property, who kill cows, steers and more particularly calves, who cut fences, who intentionally drive cattle away from water holes, and who leave gates open, who are responsible for the present

feeling and who will be responsible for any necessary restrictions which may possibly be forced on all hunters in the future.

It is probably true that the average cattleman does not fully appreciate what is done in his behalf by the Fish and Game Commission. This Commission is constantly endeavoring to secure the passage of reasonable laws which will be possible of enforcement and which will protect game and the rights of cattlemen at the same time. Probably comparatively few cattlemen know that the $2 paid for a hunting license by each hunter, goes into a fund for the paying of a bounty on mountain lions which are killed. The Fish and Game Commission is the only organization in the state which pays any bounty on the killing of mountain lions. Each year there is an average of 260 mountain lions killed on which a bounty is paid. It is quite possible to estimate that each lion would account for five head of livestock annually, or in other words, a saving of 1300 head of cattle annually to the cattlemen in the state. This saving of 1300 head of cattle by the killing of mountain lions goes a long way towards offsetting the 300 or more head of cattle killed annually by careless hunters, but that is not the whole question as pointed out above. There are approximately 150,000 head of cattle ranging on national forests in the sections of the state most frequented by deer hunters. Let us suppose that one-half of these cattle are disturbed by hunters and that the loss from such disturbing is $2 per head annually. This means a loss to cattlemen of $150,000. The saving to the cattlemen through the killing of mountain lions could possibly be estimated at about $75,000, which leaves a net loss to the cattlemen of $75,000 annually, as a result of the careless gun of the hunter and the unrestricted use of dogs.

It can not logically be expected that the cattleman will sit by and accept this loss without a word of protest. The cattleman pays for the use of his mountain summer range, and feels he is entitled to the use of that land for the entire season. If his cattle are driven from that range, he not only fails to receive what he has paid for in pasturage, but his cattle fail to make the proper gains and he is forced to provide feed for them at lower elevations which is an added expense.

As evidence of the fact that it is the few reckless hunters who spoil the privileges of the conservative hunters, I wish to state that I have in my office a bell taken from a cow coming from the range in the fall of 1921, which bell has a bullet hole through its center. It can be readily imagined that two "wild Indians" possibly in the mountains for the first time, ran out of interesting targets, and one of them said to the other, "Watch me ring the bell." Whereupon he promptly "rang" the bell. Of course, if all hunters were equally good marksmen, the loss of cattle would not be as great, but unfortunately too many such men "rang" the cow and not the bell. It can be easily understood that the cattleman owning that cow from which such a bell was taken, will not be kindly disposed towards hunters on his property, and during the coming deer season some hunter will probably fail to understand the hostility with which he is greeted by the cowman runs across him on his range.

Since it is the few who destroy the privileges of the
but one suggestion to make, and that is that the hunte
should try and personally live up to the "reminders"

back of each 1922 hunting license, and insist that every other hunter should do the same. It seems to me that this is absolutely necessary if the pleasures now enjoyed by the hunters shall continue without curtailment. It is not logical to expect that the cattlemen will continue to accept the losses and inconveniences caused by hunters, which, from their point of view, are entirely unnecessary and unjustified, without a very serious protest. The tension can be greatly relieved by the cooperation of the hunters themselves. Remember the things on the back of the hunting license. Let the hunter put himself in the position of the cattleman, then practice the Golden Rule, and the hunter will be able to enjoy his hunting privileges for a much longer time than if some other policy is followed.

POSTED PROPERTY AND A SOLUTION OF THE HUNTING PROBLEM.*

By Captain Frank Winch.

Rod and gun clubs dot the horizon of America, and their name is legion. Ordinarily, their tenure of life can be measured in inches on the yardstick of time. A few fellows get together and decide to create a club. Officers are elected, an assessment is levied to give the right tone and color to the treasury. The layout, then, from the average angle, is complete. For the next six months or so, the club functions after a fashion. Then happens the inevitable. One member drops out, then another, and more until only a few of the standbys, honest-to-goodness-gun-cranks, encircle the bewildered secretary and ask "what's the matter?" The answer not forthcoming, more guns desert the locker, and in the finality we find the remnants of So and So Rod and Gun Club only a shattered wreck of hopes, the sign comes down and the whole thing is cobwebbed in reminiscence.

Why?

To my mind the crux of the situation lies in the fact that we build our structure from the top in place of starting at the bottom. We overlook a fundamental without which no club ever has been or ever will be successful. We make every preparation for the hunt in the matter of clothes and sporting impediments, but we contribute to a fateful negligence when we are remiss on the subject, "How to Hunt Posted Property."

Every sportsman who has gone afield has had the solution of this situation at hand. We have had the posted property thing thrust at us, glaringly, and impressively on every milestone of our journey. Once solve the question of hunting posted property and you have rendered to the *n*th degree of simplicity the successful career of your rod and gun club.

Posted signs are more generously sprinkled about than the stars in the milky way, and the tendency seems to be headed toward trespass warnings on what little ground has been overlooked. There are certain states where it is impossible for the stranger to hunt unless he places himself in the middle of the public highway and risks a shot between

*From Sacramento Union, January 29, 1922.

glares of the observant farmer on either side of the fence. Reducing the problem to its elementals, you will find that the farmowner and the landowner is the barrier that stands between your club's success or failure.

Right here permit me to emphasize a point—the farmer and the landowner have found ample justification in posting their property. Broken fences, undone gates, injured stock and in many instances depredations and vandalism as surprising as they have been costly, sponsor the attitude of the farmer in keeping city sportsmen from his domain. Without a place to hunt and fish, without an interest by the hunter and angler in the propagation and conservation of game, without the good will of the farmer, the rod and gun club curls up and edges away from the necessity of existence.

The amelioration of this condition has engaged the attention of sportsmen for years. In isolated cases some good has been done, though the tendency has been a reaction which at best must be termed provincial.

The Eisner National Rod and Gun club plan appeals to me as being the soundest method of solving the sportsmen's dilemma. The objectives of the Eisner plan are to first, last and all the time recognize the farmer's rights as a sportsman and landowner; to seek the cooperation of the farmer by cooperating with him to protect his property; to assist him in securing game for propagation and see that in some manner he is reimbursed for the trouble; to share with the farmer the burden as well as the pleasure of hunting and fishing; to truly balance the administrative authority and manipulation of rod and gun club affairs by having in the directorate an equal number of farmers and city sportsmen; to work with the farmer to the end of securing such legislation as will work to his best interests and those of the majority; to encourage a spirit and morale of better sportsmanship, a closer observance of the game laws, to foster the effort to reduce hunting accidents; to emphasize a true regard for wild animal life and the necessity of game conservation.

These are the basic principles of the Eisner plan which starts at the beginning, right where it should, and this is the local unit of organization. The local club shall have as its officers a president, a vice president, secretary and treasurer and eleven directors, which shall be composed of five farmers, five city sportsmen and the deputy game warden. Membership is open to every farmer in the county and to all sportsmen who have been able to secure hunting licenses, and over these the club will eventually exercise control.

Each member is given a numbered card and at certain periods the farmer members receive bulletins giving the names, addresses and number of those belonging to the organization. The hunting grounds are posted with trespass signs issued under the seal of the national organization and none but members are permitted to enter these grounds and then only after announcing his name and number to the landowner, who shall hold the hunter responsible for any damage done to the property on the day so occupied.

Should a complaint be lodged against any member for damage or the violation of the game laws, the offending member is summoned appear before the directors and the deputy game warden w

chairman for the hearing. The number of clubs in any county shall be restricted; each club, however, takes its name from the city, town, or village in which it is organized. From each club in the county is selected two members, one a farmer and the other a city sportsman who do not hold office in the local organization. These two men will represent their unit by acting as directors of the state organization, composed of all the clubs in that state.

The principal other officer of the state organization will be a secretary and his office shall be located at the state capital, where he may keep in touch with the legislators and be in a position to promote such legislation as the membership body may deem necessary. The state associations in turn will form the National Federation of Rod and Gun Clubs of America, the main officers of which will be two directors from each state, one a farmer and one a city sportsman, with the national secretary maintaining an office in Washington, where close cooperation can be given the federal authorities on all matters pertaining to hunting and fishing.

The policies outlined can be broadened in scope and should be, to include reforestation problems and the dissemination of valuable educational information along with the repopulation of waste land with wild animal life. These are the problems that the national organization could and would take hold of with a giant's grip. This done we arrive at the solution of how to "Hunt Posted Property."

CALIFORNIA FISH AND GAME

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All material for publication should be sent to **H. C. Bryant, Museum of Vertebrate Zoology, Berkeley, Cal.**

AUGUST 1, 1922.

"Bag limits are crude and subject to great variability. If you halve the bag limit and triple the number of hunters in a given decade, you are still drawing on your principal, whereas the number of game refuges and consequently the breeding stock can be steadily increased in proportion to the demand for game."—(Bulletin Amer. Game Prot. Assoc., Oct., 1921.)

UNITED STATES FOREST SERVICE REPORT ON GAME CONDITIONS.

An agreement between the United States Forest Service and the California Fish and Game Commission, entered into in 1920, provides that the Forest Service shall report annually to the Commission game conditions within the national forests of the state. This report for 1921 contains a mass of valuable data relative to fish and game. The more important recommendations of forest officers include additional game refuges and enlargement of several of those already established; reduction of the bag limit on deer; the need of more reliable information on the number of deer in each particular locality, and particularly the number of bucks killed annually; and the need for additional game wardens to improve law enforcement.

The report shows that sage hens have been so reduced in Mono and Inyo counties that a closed season is recommended. Tree squirrels in southern California are becoming so rare that a closed season for a term of years is becoming almost a necessity. The toll taken of mule deer in Lassen and Modoc counties threatens the extinction of this species and better protection must be given it if a sufficient breeding stock is to be maintained. As in past years, the report on grouse is rather discouraging. This bird, although seldom hunted, is hardly holding it own through most of the mountain districts. Encouraging reports are made on the increase of the few bands of elk to be found within the national forests and the report on mountain sheep and antelope is also encouraging.

Tables give an estimate of the number of big game animals within the national forests of the state. The estimated total of deer is given as 184,785, and the reported kill for 1921 within the forests as 7,067. The estimated number of elk is 79; that of mountain sheep is 775, the latter being a very pleasing total.

Another table shows that forest officers, during the calendar year of 1921, prosecuted 66 cases for violation of fish and game laws, the fines amounting to $2,745.

GAME REFUGES POPULAR.

Judging by the increased demand for new refuges and for an extension of the boundaries of those already established, it is quite evident that in the eyes of the public the game refuge is popular and has justified its place as a conservation measure.

Where deer concentrate in certain areas during the hunting season a large toll is taken by hunters. There is no more satisfactory means of reducing this toll than to set aside an area as a game refuge and such a recommendation usually follows. This would at first appear to make deer harder to find and hunting more difficult. As it works out, however, the safety of the breeding stock within the area causes an increase which spreads out to the surrounding territory, furnishing better hunting. Many deer hunters are ready to testify that hunting has improved in the areas near the big game refuges.

There is a tendency, due to the popularity of the refuges, to demand the setting aside of numerous large areas. Should the demand continue, there is danger of usurping too much of the hunting ground and causing a reaction and change in sentiment that would perhaps destroy many of the refuges now in existence. It would seem best to proceed cautiously and to select with care a few out of the many recommendations for new refuges.

THE HUNTER AND THE LANDOWNER.

Oftentimes, from the standpoin
landowner, the hunter is no
property, and consequently is
tolerated. "Why must I rai

quail for these city sports that come out hunting on my land, breaking down my fences, leaving my gates open, and carelessly killing my livestock?" is the usual plaint. That there is some justification for this viewpoint must be admitted. In recent years, hunters are finding the law of trespass more closely enforced and they are coming to their senses with the result that the hunters themselves in many parts of the country are carrying on an educational campaign to make the farmers rights better respected. In some instances, rod and gun clubs and fish and game protective associations have gone so far as to put up signs offering rewards for information leading to the arrest and conviction of anyone damaging the property of another while in the pursuit of game. Adherence to such rules as the following are advocated:

1. Respect the rights of the owner of this property; he is a good fellow or it would be posted.
2. Make good any damage you do, and report that done by others. You may want to come again.
3. Don't throw away a lighted match, cigar or cigarette. Aid in fire prevention.
4. Obey and assist in enforcement of fish and game laws of the commonwealth. Notify nearest game warden of violations.
5. There are two kinds of sportsmen: the regular guy and the piker. Where do you fit? It is a decided compliment to be known in your community as a clean sportsman.

Certain it is that the future privileges to the man who hunts or fishes depend upon the actions of the men who take the field today. In some way there must be worked out a closer cooperation between the landowner and the man who hunts if wide open fishing and hunting is to continue, and the usual "get out" of the landowner becomes an obsolete expression.

STRIPED BASS SCARCE IN NEW YORK.

The editor of the fishing and hunting section of the "New York Evening Mail" points out that the 1920 season's catch of striped bass for the State of New York was only 24,437 pounds. The catch in California during the same period amounted to 671,731 pounds.

The original stock of striped bass used for introducing this fish into California waters came from the neighboring state of New Jersey. The first introduction was made in 1879 with fish from the Neversink River, and a second introduction was made in 1882 from fish taken in the Shrewsbury River. From a state with no striped bass, California has come to be a state with a much better supply than that to be found at present in eastern states from which our original supply was taken.

Doubtless protective measures are largely responsible for the continued supply of this splendid food and game fish. As early as 1889 it was feared that the recently introduced striped bass were being exterminated before they had come to maturity and had a chance to reproduce. A county ordinance in San Francisco was accordingly passed, prohibiting the sale of striped bass under eight pounds in weight. Laws now provide against the shipment of striped bass out of the state; prohibit the sale or shipment of striped bass less than three pounds in weight; the sale of striped bass of over ten pounds in weight between April 1 and May 31; the sale of striped bass of any size between June 1 and July 31, or between September 17 and November 14; the taking or having in possession at any time of any striped bass of less than twelve inches in length; the taking within District 2 of more than five striped bass per day; the taking of striped bass between one hour after sunset or one hour before sunrise, or in nets on Saturday and Sunday, and the use of nets with a mesh smaller than five and one-half inches. Besides this, fully 1000 miles of sloughs in the San Francisco Bay region have been closed to commercial striped bass fishing. As a concession to the angler, a person may have in his possession, in any one calendar day, not to exceed five striped bass, between twelve inches in length and three pounds in weight; but such striped bass must be caught only with hook and line and must not be bought, sold or offered for sale.

It can be seen, therefore, that careful protection has been given striped bass in California, in fact, greater protection than has been afforded in eastern states. Protection of spawning fish, closed seasons, size limit and limited sale, all contribute to the safeguarding of this valuable fish.

POND FISH FURNISH MANY EGGS.

A splendid system of breeding ponds has been maintained for many years at the Mount Shasta Hatchery. A fine supply of trout eggs is annually obtained from these brood fish. This season a total of 8,000,000 eggs was secured. The importance of this steady supply is apparent during such seasons as the past winter

when spawning operations have been made very difficult by the heavy snows and the high water. In many instances the water has continued to overflow the racks, and in some cases the racks have been completely washed out, so that they had to be replaced. Such difficulties, combined with that of deep snow, makes spawn taking uncertain.

It is quite apparent that if the pond systems of our hatcheries could be tripled, a dependable supply would be assured, despite adverse weather conditions.

COUNTY USE OF LICENSE FEES.

Almost every sportsmen's organization formed in the state comes to the decision that its particular county is being unfairly treated and that it is not receiving patrol and fish for planting equivalent to the number of license fees paid into the preservation fund from that particular county.

Patrol and fish distribution is allotted as equitably as is possible. If fish and patrol service were distributed according to license fees, the counties with the larger cities would use practically all of the funds, and certain counties, where people spend their vacations, would receive no fish for planting and no patrol service. Alpine county, for instance, has a population of a few hundred, whereas residents of other counties annually use the fish and game resources. Certainly it is apparent that the present system is far more dependable than any distribution of fish according to counties.

GRAZING ENDANGERS GAME REFUGES.

A visit to many of the state game refuges will show that game is not receiving adequate protection, due to the destruction of food supply by cattle and sheep. Food supply is one of the most important factors concerned in the welfare of any species and the grazing of cattle and sheep in the refuge means a lessened food supply for game. Those conversant with conditions maintain that the disappearance of grouse in the higher mountains is due largely to the pasturing of sheep. Sheep are taken to the high mountain meadows at just the time when the grouse are nesting and the nests are trampled out and the grass cropped so clean that even a food supply for these birds is largely destroyed. Recent reports from Game Refuge 1D in Trinity County indicate that so many cattle are allowed to feed within this refuge that browse has become very scarce for deer. Any area will support only the number of big game animals for which there is an adequate food supply. A diminished food supply means a diminished number of deer.

Unless more attention is paid to the improvement of grazing inside game refuges, these areas will not be performing the service for which they were set aside. Undoubtedly cattle men and sheep men will oppose any restriction of grazing but there should be sufficient public sentiment to successfully close to grazing at least portions of each game refuge.

CRAPPIE FISHING IMPROVES NEAR SACRAMENTO.

The crappie appears to be taking the place of the Sacramento perch near Sacramento. This species seems to become more abundant from year to year, and every week-end and holiday sees hundreds of men and boys angling for this splendid game fish.

The crappie takes the fly readily and is easily caught on a spinner. Anglers maintain that the crappie compares favorably with the black bass as a pan fish.

THE UNAPPRECIATED SHAD.

The market for shad continues so poor that fishermen are tempted to throw back into the water all of the buck shad secured in their nets. Fishermen have been receiving but two cents per pound for buck shad and it retails for about six cents. Roe shad have a somewhat greater demand, but after the roe has been taken from the fish, it has but small value. In eastern cities the public is glad to pay 90 cents a pound for buck shad and anywhere from $1.25 to $1.50 for roe shad. Here in California at the height of the season one is able to obtain a good three-pound fish for about 25 cents, and yet there is no sale for it. Planked shad does not have the attraction for the Californian that is has for the Easterner. The person who can make shad popular in California can make his fortune. Someone ought to try placing filet of shad on the market to see if this would be more attractive than the fish in the round.

SEVERE WINTER HINDERS FISH-CULTURAL OPERATIONS.

The accompanying photograp
the Tahoe region should carry co
that the fishcultural department
ters increased difficulties during
winters. Most of our trout
early in the spring and in
parts of the mountains. Ac-

FIG. 75. Mt. Tallac Hatchery, April 1, 1922, when spawning operations began in the Tallac region. Photograph by Jos. Sanders.

localities during February and March is often very difficult and yet the spawn-takers must reach the spawning stations before the run of fish is over. This often necessitates covering many miles on snowshoes, and living and working for many weeks in situations comparable to the arctic regions. Often before the streams have been cleared of ice it is necessary to build racks and traps. The actual spawning of the fish must usually be accomplished with snow many feet in depth.

A successful take of eggs is dependent upon a group of men who forego many bodily comforts in order to reach the spawning grounds in time, and great credit is due these loyal workers.

FIG. 76. Domingo Springs Hatchery, as it appeared on the arrival of spawn. Taken on April 2, 1922. Cross marks roof of hatchery. Photograph by J. W. Ricker.

PREDATORY ANIMALS DESTROYED.

et filed by Inspector charge of the cooper- nal service, conducted al Bureau of Biolog- California State De- lture, shows a grand als taken during the July 1, 1921, to e detailed list shows obcats, 64 skunks, 41 18 badgers and one ents of stockmen and average decrease in and poultry amount- It is estimated that

s o. ave st o 88½ per c... only one out of otes is found, ... increase the foregoing fig..."

To the sportsman taught to bel that predatory mammals have a very rect bearing on the abundance of gam this report should be very pleasing. T the conservationist who would save na- ture as near unspoiled as possible, such a report is disturbing. To the biologist interested in the interrelations of living animals, such a report emphasizes that difficult problem presented by man's inter- ference in the "balance of nature" and the consequent disturbances which entail endless artificial control measures.

DEER REPORTED DYING IN SEVERAL SECTIONS OF STATE.

It is not unusual for reports of dead deer to come in from the coast range mountains from Sonoma County north- ward. A number of deer appear to die each year in this section of the state even when there is no evidence of such an epidemic as appeared in Trinity County a number of years ago. This spring, re- ports have come from such widely sepa- rated places as the Mount Hamilton re- gion in Santa Clara County, and parts of Siskiyou County, that deer were dy- ing in considerable numbers. The report from the Mount Hamilton district, made by Dr. W. H. Wright of the Lick Ob- servatory, states that the deer appear mangey, with large white patches on the sides.

HEARINGS HELD ON USE OF FOOD FISH IN REDUCTION PLANTS.

During the week beginning April 10, hearings were held in San Pedro relative to a violation of the law which provides that canneries may use not more than 25 per cent of the monthly catch in re- duction plants. At the last session of the legislature, legislation was provided de- signed to prevent the use of food fish for the manufacture of fish oil and fish meal. In recent years each cannery has erected reduction plants in order to utilize the waste from the plant. As there was a tendency because of the de- mand for fish meal and fish oil, to utilize many sardines and other fish suitable for food, it seemed best to legislate against such a practice. The law pro- hibits the use of food fish in reduction plants, but provides that after a hearing permission may be obtained from the Fish and Game Commission to make use of unavoidable excess catches when no other market is available, the amount so used, however, in no case to exceed 25 nt of the catch for the month. On ry 11, 1922, the Fish and Game ission issued an order stipulating he catching of fish for use in a ion plant would not be tolerated. t the past few months several ca ies in southern California have failed to stay within the law and have apparently been evading the law and the regulations issued. As a consequence a complaint was filed and hearings have been held. The hearings have clearly shown that these canneries violated the law during the month of February. The penalty provided by law is a suspension of the license to operate for a period not to exceed 90 days. As the sardine season is over and will not be resumed for sev- eral months, and as each of the canneries will begin the canning of albacore and tuna in June or July, it has been de- cided to impose the maximum penalty in order that it may mean something. A suspension of the license for 90 days will keep some of the canneries closed during the early part of the albacore season.

VIOLATORS HEAVILY FINED.

A. Russo and five Italian fishermen were arrested by Deputy Burke at Visi- tacion Valley on three charges: (1) Fishing in District 3; (2) Using an illegal net; (3) Possession of striped bass. The case was tried before Judge Griffin of Redwood City on April 6, and Mr. Russo, who is an old violator, was fined $250 on the first charge and given 100 days in jail. Four of the other fishermen were fined $100 each, making a total of $650 in fines. The fifth fish- erman, who was an old man of sixty- nine years, was dismissed.

THE RURALIST'S ATTITUDE ON HUNTING

Everyone who talks to less settled portions of finds that their attitude

quite different from that held by the city dweller. The point usually made is that since the owner of the land provides food and shelter for game, the landowner should have a right to utilize it for food. The point is always made that the city sportsman comes out into the country and kills his limit of deer, all of which he is not able to use, and consequently, almost invariably leaves venison to spoil in the woods. On the other hand, the resident of the hunting section maintains that he takes a deer when it is needed for food and utilizes the whole animal. Anyone who studies this situation must in fairness agree that the rural resident really has foundation for his attitude. Had city sportsmen properly conducted themselves, this point of view would have much less foundation, for, in America, game does not belong to the owner of the land but to all the citizens of the commonwealth.

THE GAME OF THE SMALL BOY.

Small game is not altogether the quarry of the boy hunter. Many men turn their attention to small game when unable to take the journey necessary to reach big game. Probably several times more rabbits are killed in California than all the big game put together. Originally the stock of rabbits was so great that it seemed almost impossible that the hunter could make any impression on their numbers. At the present time we find interest sufficient to support a closed season throughout the state, in spite of the oft-repeated accusation that rabbits are destructive to growing crops. In southern California, where rabbits cause more damage, sentiment is not so favorable to the closed season.

One state in the Union, having used up its supply of rabbits, has been paying thousands of dollars to secure specimens for restocking. Whether California will ever find herself in a similar situation we can not say, but now is the time to look to the future and see that a sufficient breeding stock is saved annually to provide food and sport for the small boy and the local sportsman. The comparative abundance of small game is likely to lead sportsmen to center attention on big game and forget the needs of the quarry of the boy hunter and the farmer.

"MACHINE GUNS VERSUS SEA LIONS."

A paragraph with the above heading appeared in a recent number of the Fish Trades Gazette (Organ of the National Sea Fisheries Protective Association, London) as follows: "The Canadian Department of Fisheries intends to wage an active campaign this summer against the hair seal and the sea lion—the principal enemies of the salmon, says the "Times Trade Supplement." The seals will be attacked in their rookeries off the Queen Charlotte Islands and the west coast of Vancouver Island. Machine guns and rifles will be used, the main effort being to exterminate the young of the sea lions. In past years hair seals have done great damage among the salmon. At one time bounties were offered for them, but of late years this practice has been discontinued."

The economy of thinning out or exterminating the seals and sea lions on the Canadian coast need not here be discussed, for surely the responsibility for such action would not lightly be taken without a thorough inquiry and analysis of conditions. If the sea lions have increased until they are a menace to the fisheries, a reduction may well be undertaken, but the reduction should be under complete and exact control.

The method proposed may be open to considerable criticism. It seems wasteful, unnecessarily cruel, to lack control, and especially to be without provision for knowing exactly the number of sea lions killed each year.

Machine gun fire into a mass of sea lions can not help but result in wounding many of them, leaving them to suffer A shot sea lion will use its last strength in plunging into the sea where it at once sinks. Unless shot through the brain, spinal cord or heart it will have life enough to do this, and many will be wounded in parts that are essential to life but may not lead to fatal results for several days. The interval can not be contemplated with any pleasure.

Each female killed before its young can find food for itself will mean the slow starvation of the young. On the California coast the sea lion nurses its young nearly up to the time the next young is born. In Alaska the nursing season is apparently shorter. Just at what age the young could shift for itself is not known. Probably it could obtain solid food within a few months of its birth, but surely not at a time when it is still on the rookery in numbers, which would be the most profitable time for machine-gun fire. To be sure, there is a time in the breeding season, when the young are a few weeks old, that the adults may be driven from the rookery, and the young only may then be the re-

cipients of the rain of bullets, but there are surer, more merciful methods than such a hit-or-miss one, if the rookery can be landed upon. The death of each female means the starvation of its young, because by no possibility will a female allow any but its own young to nurse.

The method is wasteful because the skins may be made of commercial use, if a number can be obtained at one time, or if the supply is at all regular. The coast would doubtless yield several hundred skins each year.

Numbers among the sea lions can be easily and exactly controlled by the death of the young. Firearms of any kind are not necessary. The young do not leave the rookery until they are 5 to 6 weeks old, and a man with a club could land on a rookery and kill 500 in a day. This method would be humane, and doubtless would be at least profitable enough to make the sea lion controlling body self-supporting. By such a method a definite number could be killed each year and the result watched that there may be no danger of complete extermination.

Of course some rookeries could not be landed upon at any time, and that is probably the reason for the suggested machine-gun method of control.

That this method would be efficient is well shown by the black, or California, sea lion the young of which was hunted by sealers on the rookeries so that within a short time that species was so reduced in numbers that extermination was feared. It is now protected on the Santa Barbara Islands, where it breeds.

Mr. C. H. Townsend wrote a paper on "The Utilization of the Sea Lion (Zool. Soc. Bull., Mar., 1919), in which he advocates the killing of the young, as is done in the Newfoundland seal fishery. If some of our California rookeries continue to increase in size (as the Ano Nuevo Island rookery apparently is doing), especially if it can be shown that the increase is not just local, but of the entire coast, this herd may have to be kept within a reasonable size by some such method as that here considered.—EDWIN C. STARKS, Stanford University, California.

THE COST OF LAW ENFORCEMENT.

According to statistics compiled by the Indiana Department of Conservation: the cost to the State of New York for each of the 4090 convictions last year amounted to $79.57. The State of Missouri, with about one-sixth the number of salaried wardens, paid $671.04 for each conviction. The later amount even exceeds the cost in western states, where vast areas of big game country must be patrolled by a single man, and convictions are necessarily few and far between.

PRINCIPLES OF MANAGEMENT.

"In order properly to manage our wild life resources, particularly the fish and game, certain definite action is necessary. Protective measures, as well as methods to increase the production of fish and game, must be based on correct information regarding natural history. The public and particularly the sportsmen, must appreciate the reasons for such measures and provide a public sentiment that will demand their being carried out. The administration of the game department must be such as will sincerely strive to improve conditions and have the interests of the sportsman at heart.

"In this connection let me emphasize the necessity for the wild life enthusiast and the naturalist to recognize the great number of men who are just ordinary sportsmen. Working by himself the naturalist plays rather a lone hand but by active cooperation with the sportsmen he can give them much information they are anxious to obtain and can do considerable in encouraging better sportsmanship. In the end it is the attitude of the average man which governs the success of protective measures and it is through him that the greatest results can be obtained."—S. E. LOCKE, Ogden, Utah.

HANDSOME GIFT FOR WILD LIFE PROTECTION.

The National Association of Audubon Societies has just received a cash donation of $200,000, the largest of numerous donations which through the years have been received from the same source. All the gifts of this friend of wild life have been made with the distinct understanding that the name of the donor be withheld. The recent check is to be known as the "Permanent Fund of 1922" and the interest is to be used along the lines of endeavor specified by the giver, which are as follows:

1. For the education of the general public in the knowledge and value of useful, beautiful and interesting forms of wild life, especially birds.

2. For the actual protection and perpetuation of such forms of wild life on suitable breeding and other reservations.

3. For protecting and maintaining adequate protection for such [illegible] of wild life in all parts of the [illegible] sphere.

4. Or for any one of

TWO GAME REFUGES RECOMMENDED FOR PLUMAS NATIONAL FOREST.

It has been roughly estimated by the Forest Service that there were approximately twenty-five thousand deer ranging in the Plumas National Forest in 1921. However, it has also been estimated that more deer were taken from Deer Creek Meadows and Dixie Valley in 1921 than in all the rest of the National Forest, showing that deer concentrate there each fall. It is now being strongly recommended that two new game refuges be established, one in the vicinity of Dixie Mountain, the summer range for the mule-tailed deer, and the other in the Deer Creek Meadows. The elimination of hunters from these areas would greatly reduce the annual toll. These refuges would also greatly benefit quail and grouse, since sheep would be excluded. Grazing sheep constitute one of the greatest menaces to nesting quail and grouse. —GEORGE W. CHAMBERLIN, Quincy, California.

GAME AS A NATIONAL RESOURCE.

The United States Department of Agriculture has rently issued a bulletin (No. 1049) by Dr. T. S. Palmer, expert in game conservation, on the subject of "Game as a National Resource." This bulletin discusses briefly the value of game as food and as an asset to the individual and to the state, reviews the various methods by which estimates of such values are obtained, and points out some of the causes of present depleted conditions and some of the methods by which game resources may be preserved and increased, together with the expense involved in work of this kind.

A few of the outstanding facts gleaned from this publication follow:

"Of the 19 states north of latitude 42 degrees and Mason and Dixon's line, 16 had deer hunting in 1920, the exceptions being Connecticut, Rhode Island and North Dakota. Of the 29 states south of this line, Delaware, Maryland, West Virginia and nine states in the corn belt had no deer hunting and Missouri had very little. The possible deer crop is more than twice as large in the northern tier as in the southern, the possible kill under normal conditions being respectively 60,000 as compared to 25,000. The only states to the south where the annual kill is likely to exceed 5000 are California and Texas.

"In a number of states serious inroads have been made in the breeding stock because until recently laws have permitted the killing of does. In New York in 1919, when the season was open on both bucks and does, probably more than one-third of the total number of deer in the state were killed.

"Elk formerly occurred and were hunted in nearly every state. Estimates made a few years ago showed a total of approximately 72,000 elk in the United States, whereas today it is doubtful if the number is much in excess of 52,000, of which about 25,000 are found in the Yellowstone National Park and adjoining regions. Elk hunting has been closed in most states and is now restricted to a few counties in Idaho, Montana and Wyoming, where the number is limited to one to each hunter.

"Rabbits probably constitute the largest, cheapest and most generally available supply of game in the United States. Abundant almost everywhere, shot for sport and market, and free from non-sale restrictions in many states, they form an important item of food supply. The jack rabbits in the West, which are a serious pest in some states, are destroyed in enormous numbers, but only a relatively small number are placed on the market and find their way to eastern states. Cottontails, however, are found in every state in the Union and during the autumn and winter are hunted almost everywhere. In 23 states there are close seasons and other regulations, but in the other states there is at present no restriction on hunting. These animals form a nutritious and relatively cheap meat, which is thus available to a considerable number of persons who can ill afford to pay high prices for beef, mutton and pork.

"Every state has some species of quail, either native or introduced. Probably no game except ducks is more generally hunted. The sale of native quail is now prohibited throughout the United States except in a few counties of North Carolina.

"The hunting license fees now required in most of the states constitute a comparatively modern source of income, dating back only to 1895.

"Of the various methods of increasing game resources which have been suggested or put into practice in the United States, four merit special notice, namely, protecting game, establishing refuges, restocking depleted areas, and breeding on game farms.

"Artificial game propagation is still in an experimental stage, and the kinds of birds which can be produced in large

numbers with any degree of certainty are at present very limited.

"In regulating seasons, certain principles are generally considered fundamentally important. Among these are the prohibition of summer shooting—that is, during the breeding season; the prohibition of spring shooting, while birds are on their way to the breeding grounds; and the protection of females of big game, particularly in the case of deer.

"The states which have the largest aggregate areas devoted to game refuges are California, Minnesota, and Wyoming; those which have the greatest number of individual refuges are probably Michigan and Pennsylvania.

"Two elements are essential for the success of any game refuge: First, permanency; and, second, sufficient area in a compact body. For the protection of big game, long narrow strips of territory are comparatively worthless and constantly shifting boundaries furnish little actual protection.

"No field of conservation is more important than the restoration of game in regions where it has been reduced to the vanishing point or completely exterminated. Plans for bringing back the game usually involve legislation, introduction, or propagation.

"The principal expense connected with the protection of game is the maintenance of a patrol adequate to prevent violations of the laws.

"Estimating the total amount of each kind of game in any state would make it possible, by revising and comparing the estimates from year to year, to tell whether the stock is increasing or whether the total number killed exceeds the annual increase."

That enumerations and valuations of the annual kill of game are not as yet stabilized is evidenced by the wide divergence of the valuation placed upon the various kinds of game. In the tables given, New York placed a valuation of $75.00 on each deer, whereas Virginia estimates the value of each deer at $26.00. It is to be hoped that some more uniform valuation may be determined upon in the near future.

CONSERVATION IN OTHER STATES.

MISSISSIPPI PLANS GAME LAWS.

Mississippi is one of the few remaining states that has no game laws or any organization to protect fish or game. The first sign of awakening is now at hand, however, for the Mississippi State Game and Fish Development League was recently organized at Vicksburg. This organization is backing attempted legislation in the Mississippi legislature.

LANDLOCKED SALMON PLANTED IN IDAHO.

The state of Idaho last year planted eastern landlocked salmon under ideal circumstances and plans to continue the introduction of this species during the next two seasons.

CONSERVATION IN MEXICO.

For some time it has been advocated that the United States Government enter into a treaty with Mexico for better protection of such of our migratory birds as winter in that country. Fortunately the Mexican Government is now showing an interest in the protection of wild life, and as a result that country is planning the passage and enforcement of the first game laws to be enacted in Mexico. In furtherance of this plan the Mexican Department of the Interior recently sent Mr. Delfino P. Cedro to the United States to study our methods of conservation, our laws and their enforcement.

UNITED STATES FOREST SERVICE COOPERATION.

PAUL G. REDDINGTON, Editor.

ELK INCREASE ON CLEVELAND NATIONAL FOREST.

One calf elk was reported in the band of 12 liberated in the Laguna Mountains in 1919. Seven of these elk located near the Laguna Recreation Area and are apparently in good condition. The other five drifted to the lower elevations along the desert slopes and not much is known as to their present number or condition.

GAME CONDITIONS ON THE ANGELES NATIONAL FOREST.

It is estimated that about 160 mountain sheep within the forest are principally in the San Antone and Twin Peaks country in refuges 4A and 4B. On the Forest outside of the refuges very little hunting is done as the deer immediately go into the refuges soon after the opening of the hunting season. Even in the refuges deer are not as plentiful as they should be considering the length of time they have been protected. Deer are found in greater numbers around the more frequented locations than in the more remote portions of the refuge. This is attributed to mountain lions being more plentiful in the less frequented areas. It is also reported that the mountain sheep have not increased to any extent in the past seven years on account of mountain lions and the work of poachers. Several sheep carcasses partly devoured have been found.

A FEW ANTELOPE LEFT IN SOUTHERN CALIFORNIA.

Antelope may still be found along the foothills of the Tehachapi Range and in Antelope Valley on the Santa Barbara Forest where there are at least 10.

INTRODUCED ELK THRIVE ON SEQUOIA NATIONAL FOREST.

A few elk are reported on the Sequoia Forest. It is believed they drifted from the Sequoia National Park. There were some Buttonwillow elk placed in the Kaweah country several years ago. A stockman reported seeing two yearling elk last summer, which indicates the herd is increasing.

MOUNTAIN SHEEP ON THE INYO NATIONAL FOREST.

It is estimated there is a total of 365 mountain sheep on the Inyo Forest. They are found principally on Wyman Creek, Waucobe Canyon and Piute Mountain, Goldale and Birch Mountains, Pine and Rock Creeks. They seem to be slowly increasing through the protection afforded by a closed season and a close compliance with the game laws.

GAME INTRODUCED ON THE MONO NATIONAL FOREST.

Carson Valley sportsmen are taking an active interest in game propagation and protection and have introduced ring-necked pheasants, bobwhite and Gambel's quail. The ranchers in this locality take especial care in feeding these birds during heavy snow.

MANY DEER KILLED ON LASSEN NATIONAL FOREST.

It is believed about 5000 hunters visited he Lassen Forest the past hunting season, and that 450 deer were killed. The mule-tail deer on this Forest are reported as rapidly decreasing. During the war period there were relatively few hunters and this species of deer rapidly increased. However, with the tremendous increase in the number of hunters since the war, it is believed this species of deer is in danger of extinction.

MULE DEER IN DANGER OF EXTERMINATION.

The Columbian blacktail and the mule deer are both found on the Shasta National Forest. It is estimated that there are 12,000 of the former and 1000 of the latter, or a total of 13,000. The mule deer are largely found in the northeastern part of the Forest within and adjacent to the lava bed country. It is estimated that a total of 427 deer were killed by hunters during the past season, of which 134 were mule deer. This is an increase of over 43 per cent over last year in the number killed of this species, there being only 76 killed during the season of 1920. There was a large increase in the number of hunters in the mule deer country last year.

ELK ON THE SHASTA NATIONAL FOREST.

Several years ago the Elk Lodge at Redding shipped 50 elk from the Yellowstone Park and placed them on this Forest. About half the number died soon after they were liberated. The remainder have increased up to about 60 head and are now located on Brock, Lick and Flat creeks and on Brock Mountain. Last year several calves were seen. It is believed this herd has now become permanently established and will continue to increase in numbers.

MODOC COUNTY PAYS BOUNTY ON COYOTES.

Last year Modoc County paid bounty on almost a thousand coyotes, many others being killed upon which the bounty was not collected. While coyotes prey chiefly upon domestic stock in this locality, it is known that they kill a great many deer on the Modoc National Forest.

ELK ON THE KLAMATH NATIONAL FOREST.

There is a band of seven elk on the Scott River District of the Klamath Forest. While this is only an increase of two over the number reported last year, it is believed these elk are now doing well and will increase in numbers more rapidly in future years.

TRINITY COUNTY PAYS BOUNTY ON COYOTES.

During the past few months local hunters with dogs have killed 10 mountain lions in and around game refuge 1D situated within the Trinity National Forest. Trinity County has been paying a $3 bounty on coyotes for the past several years and from 1908 to 1921, inclusive, has paid out a total of $11,992 in bounties.

CALIFORNIA FOREST HAS BIGGEST RECORD OF DEER KILLED.

During the hunting season of 1920 a record of 1200 bucks killed by hunters was obtained by Forest officers of the California National Forest. It is safe to assume that this does not cover half of the deer killed, which would probably total 3000. The great majority of bucks taken are forked horns, and it is a common statement by hunters that larger bucks are much scarcer than formerly. This is in all likelihood due to the great increase in hunting, for during the last ten years the number of visitors to this Forest has easily increased six times, and is conservatively estimated at 6000 for the season of 1921. Three-fourths of this number visited that portion of the Forest included within Game District 2, which has the early opening date of August 1.

VIOLATIONS OF FISH AND GAME LAWS,

January 1, 1922, to March 31, 1922.

Offense	Number of arrests	Fines imposed
GAME.		
ng without a license	13	$165 00
ng in game refuges	2	20 00
ing in posted grounds	2	20 00
hunting	1	25 00
ing without a license	3	30 60
g false statement to secure hunting license	1	40 00
non-game; possession, killing	4	170 00
possession, killing, closed season	7	195 00
possession and killing	6	300 00
meat, possession, closed season	12	360 00
, possession, killing, shipping, closed season, over-limit	14	400 00
ule, possession and killing	1	25 00
closed season, over-limit	3	50 00
ants (wild), killing and possession	4	250 00
ns, possession	1	25 00
ts, possession, killing, without license	6	125 00
s, possession and killing	10	121 00
birds, killing	1	25 00
els, possession, killing, closed season	4	25 00
possession, killing, closed season	2	100 00
ing before half-hour before sunrise	2	50 00
ing after half-hour before sunset	1	25 00
, possession, illegal	5	----------
otal game violations	104	$2,546 00
FISH.		
g without a license	4	$40 00
g in District No. 2	2	----------
nes	12	325 00
cuda	11	775 00
	5	140 00
	21	680 00
	9	145 00
nt	3	200 00
ers	6	145 00
n	1	100 00
son	2	20 00
	12	320 00
ing young smelt	5	25 00
ing steelhead above tide waters	1	100 00
net more than six feet in District No. 2	1	----------
net more than six feet in District No. 3	1	100 00
three-inch mesh net in District No. 12	1	100 00
gill net less than 5½-inch mesh for bass	2	100 00
ifting petroleum in San Francisco Bay	1	200 00
otals	190	$3,465 00
Grand total fish and game violations	294	$6,011 00

SEIZURES.

Game.	
----------	1
head	1
meat	105½ pounds
----------	1,113
----------	50 pounds
----------	1
----------	64
e	2
r	4
w lark	1
e chickens	2
----------	38
ts	16
e	14
el	1
pheasants	4
----------	9

Fish.		
Abalone	189	
Abalone	612	pounds
Abalone	90	boxes
Bass	60	
Striped bass	119	
Striped bass	70	pounds
Striped bass	1	box
Barracuda	124	
Barracuda	8,169	pounds
Clams	543	
Crabs	1,465	
Lobsters	120	
Lobsters	50	pounds
Lobsters	88	boxes
Halibut	1,825	pounds
Salmon	3	
Salmon	90	pounds
Shad	1	
Smelt	479	pounds
Sturgeon	11	pounds
Trout	5	
Steelhead trout	219	pounds
Steelhead trout	4	boxes
Illegal net	1	
Searches	13	

CALIFORNIA FRESH FISHERY PRODUCTS FOR MONTHS OF JANUARY, FEBRUARY AND MARCH, 1922.

Compiled by Fish and Game Commission, Department of Commercial Fisheries.

Species of fish	Del Norte, Humboldt	Mendocino, Sonoma, Lake	Marin	Solano, Yolo	Glenn, Tehama, Colusa	Sacramento, San Joaquin	Contra Costa, Alameda	San Francisco, San Mateo	Santa Cruz	Monterey	San Luis Obispo, Santa Barbara, Ventura	Los Angeles	Orange	Imperial	San Diego	Total	Mexican, brought into California
Albacore												60,246				60,246	
Anchovies											24,080	490,078	145		191,632	705,935	780,065
Barracuda									113	13,772						13,885	
Bluefish								32,750	99,828	316,705	980					450,263	
Bocaccio												20,905			9,486	30,391	23,916
Bonito		1,700		1,488		5,016	11,220	38								19,462	
Carp		60,895				674										61,569	
Catfish								11,972	92,391	11,274						115,637	
Chilipepper								99,676	5,515	24,393		5			192	132,409	
Cultus Cod																	
Dolphin																	
Eels	2,332	296															
Flounders								127,957	11,316	705	191	100			120	153,787	120
Grayfish	12,801		25	192			380	51,592							68,940	120,582	
Greenfish							50										
Hake								1,475								1,475	
Halibut								13,694	434	3,708	120,708	612,955	38,021		160,462	949,982	104,246
Hardhead																79,884	
Herring	5,937		170			9,539	70,345	206,446			517					213,070	
Kingfish								1,925	29,270	70,336	215	108,542			107	210,395	30
Mackerel										24,096	9,753	424,323	413		78,927	537,512	20,515
Marlin																	
Mullet														774	253	1,027	1,027
Perch	27,853	70	17,320				18	14,779	300	5,422	183	10,636	9		78	76,668	
Pike				58	153	1,196	1,074									2,481	
Pike, no								1,350		63		1,047				2,460	
												18,347	932		2,908	22,187	1,896
	2,086	1,417						204,827	59,978	159,118	33,357	558,378	880		166,758	1,186,799	20,691
								80,893	16,149	1,497						98,539	
				31,538	38,014	25,444	48,746	223		10						143,975	
								313,362	14,250	1,106		2,580				331,298	
										5,307,965	130	36,172,547			720,239	42,200,881	
												13,008			714	14,322	181
												8,446	177		6,573	15,196	6,293
	68		820							14	200	149,394	144		74,266	224,906	56,255

Sheepshead												157	1,120			4,992	6,279	
Shiner								41,335	1,850	620	2,505	1,466	874				46,650	
Skipjack																		1,654
Smelt	5,371		2,738				13,356	41,250	246	5,089	22,020	58,155	719			3,323	152,267	
Sole								1,633,593	19,840	11,455	19,595	58,844	1,495			6,328	1,750,850	
Splittail						8,375	7										8,382	
Striped Bass			160	26,030	270	19,686	71,739	7,031									123,906	
Sturgeon																		
Suckers						1,100	4										1,104	
Surf Fish																		
Swordfish												105					105	
Tomcod								7,788	1,050								8,838	
Trout—Farm																		
Trout—Steelhead																		
Tuna												625				1,806	2,431	1,991
Tuna—Bluefin																		
Tuna—Yellowfin																		
Turbot			8														8	
Whitebait								386									386	
Whitefish												8,582				495	9,077	2,491
Yellowtail												99,010	760			51,922	148,692	209,092
Miscellaneous	2,482			75			351	7,834	14,196	5,424	35,311	10,633	476				76,782	433
Total fish	58,995	64,378	21,241	66,976	38,437	77,046	255,106	2,902,925	366,726	5,962,772	269,902	38,887,664	45,138	774	1,550,784	50,568,864	1,290,896	
Crustaceans:																		
Crabs (dos.)	1,787	161	330				46	11,713	57	2							14,096	
Lobsters (dos.)																		
Shrimps			7,179					153,376			20,382						180,937	
Spiny Lobsters												44,426	2,003		50,508		97,027	490,417
Mollusks:																		
Abalones										198,990	960						199,950	6,265
Clams—Cockle	695		4,175														4,870	
Clams—Mixed	8,183		10,548								100	1,023					19,924	
Clams—Pismo									292		37,166						37,458	
Clams—Softshell		1,132	20,160				54,679	13,318									89,289	
Cuttlefish			22					4,147	5,119	21,602		405					31,295	
Limpets																		
Mussels							1,282	3,482	150	2,125							7,039	
Oysters—Eastern (No.)			1,105,511														1,105,511	
Oysters—Native																		
Scallops																		
Squid										2,572		12,927			12,607		28,106	
Miscellaneous:																		
Frogs (dos.)																		
Terrapins (dos.)																		
Turtles																		110

All amounts shown in pounds unless otherwise specified. Albacore and Skipjack cleaned. All other fish in round.

CALIFORNIA FISH AND GAME

"CONSERVATION OF WILD LIFE THROUGH EDUCATION"

Volume 8 SACRAMENTO, OCTOBER, 1922 Number 4

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FISHIN'.

In Some Lakes Near Mount Lassen, Principally, and Trout, Generally.

By ROY E. LUDLUM, Deputy Fish and Game Commissioner.

The district comprising the area of the proposed Lassen National Park has been but little used by the vacationist. Why more people have not taken advantage of trips to this wonderland is possibly explained by its seemingly inaccessibility and lack of publicity. The tourist will find a variety of interests here whether he wishes to hunt, fish, climb mountains, or just camp. This is a summer range of the mule- and black-tail deer; several well stocked lakes as well as the nearby streams will give the angler plenty of opportunity to pit his skill against the trout; numerous mountains in this volcanic region, with their boiling mud springs and ice caves, invite the mountain climber; and camp sites are everywhere.

At present the only automobile roads reaching directly into this proposed National Park are from Chester, Plumas County, to Juniper

Lake, and from Chester to Lee's Camp, Kelley's and Drakesbad, all in Warner Valley, where the tourist may secure meals, lodging and pack outfits for trips to the Mount Lassen district; these accommodations may also be had at Mineral, on the Red Bluff-Chester road.

Going to Juniper Lake, via Chester, by automobile, the tourist will be much impressed with this great body of clear, cold water with its six or seven miles of shore line. With an elevation of 7300 feet, the lake is fed by melting snow and springs, and sloping from its wooded shore it reaches great depths; a single steelhead trout may be seen floating lazily, or a school—sometimes to the number of fifty—may be seen

FIG. 77. Moonlight on Juniper Lake, showing reflection of Mount Harkness. Juniper Lake is famous for its steelhead fishing. Photograph by H. R. Basford.

swimming together forty feet under the surface; but going farther out on the lake the bottom is soon lost to view and the depth is left to one's imagination as actual measurements have not been taken.

Juniper Lake was stocked with steelhead trout, in 1915, by the Fish and Game Commission, and the wisdom of this move is best shown by the marvelous development of the fish themselves. Many limits were taken last year, and fine fish they were, weighing up to four pounds. There is a ripple on the water after about 10 o'clock in the morning, but the wind usually dies down before sunset and it is then, as well as in the early morning, that the fly fisherman comes into his own, for the trout come from the depths of the lake to the shallower water in search of the natural insects that fall on the water. A steelhead hooked with light tackle in this clear, cold water will quickly win repute for his wild rushes and spectacular leaps. The supply of these fish in this lake may be greatly increased by successive larger plantings of fry, but all the fish must be introduced as there are no spawning beds; the number of fish that can live in the lake is only limited by the food supply, and it might be possible to supply, with success, animal or plant matter, or both, as food for the trout.

Juniper Lake offers many camp sites and is a center for the auto camper, as several other lakes and many side trips are within hiking distance. It is reported that a hotel will be built this year, and that more boats and pack horses will be available for hire.

Shadow Lake, a short distance from Juniper Lake, is well named and would appeal to the artist as a study in shadows. A pretty picture it is, surrounded by green trees, its surface dotted with lily pads, together with an occasional sunken log, and a constant change of light and shadow over all. But even the "old-timer," absorbed in his surroundings, may receive a decided surprise, if, as he casually casts his first fly, a half dozen eight-inch rainbow trout rush at his artificial bug bent on its destruction! This lake is small, and like Juniper Lake, has no spawning beds and will require stocking each year. While the season is short yet the rainbows are hardy, scrappy little fellows and Shadow Lake deserves the attention that it would require to keep it replenished.

Grassy Lake is about two miles northwest of Juniper Lake, and about two or three miles farther north is Snag Lake; these two lakes, elevation 7500 feet, surrounded by high timbered mountains are connected by a small creek. Into this creek in May or June of each year comes hundreds of rainbow trout to spawn, and, together with the stocking of the fry supplied by the Fish and Game Commission, the trout have increased until these lakes are of considerable import. While somewhat difficult of access, as they can only be reached by pack train or hiking, the tourist will be well repaid for the effort required to visit the lakes. There are no boats as yet on Snag or Grassy lakes and the fishing must be done from improvised rafts or from the shore, but some of the finest of rainbows up to six pounds have been taken. Snag Lake is second to Juniper Lake in size and Grassy Lake is still smaller, but each seems to be equally well supplied with trout and the fisherman will have rare sport with flies or spinner during July or early August.

Whether or not any fish are caught, a trip to the Cinder Cones at the north end of Snag Lake is worth while and the lava beds and the flow of lava that forms the north shore of the lake are also centers of interest, for they show quite plainly the terrific force of the volcanic action. An action of force has taken place here that is too great for comprehension and the result has been the upheaval of this entire section. After spending a day here, as the tourist returns to Grassy Lake toward evening, he may seat himself on the lake shore, and, looking west toward mysterious Mount Lassen, lose himself in reverie until the great silence of the high mountains gently steals upon him: a profound silence, broken only by the wind in the pines. He may sit thus indefinitely, but when he suddenly arises and shakes off this lethargy the bigness of the out-of-doors has come to him, for he has indeed been close to nature. It matters not to the true sportsman if he has not been able to take a full limit of fish; this fact alone can not spoil his trip for him, and fortunate is the man who can go into the mountains, along the streams and to the lakes and see the wonders of nature and be thankful for his privilege to be among them.

It is a privilege to fish for trout, and added numbers each year are availing themselves of the opportunity to seek the speckled beauties. The rainbow trout, naturally wily and suspicious, has thru his experience with the ever increasing host of anglers reached a degree of

"education" that has gained for him the respect that he merits. It is more difficult to make large catches of trout now than it was a few years ago, not necessarily because the fish are becoming so much scarcer, but because, in the humble opinion of the writer, a greater degree of skill is required to take the fish. But this is as it should be, for better and more delicate tackle is needed and the angler must become more and more proficient in its use; then the life and food and habits of the trout come in for study and a field of pursuit is opened up to the ambitious fisherman that soon becomes a man-sized job. Angling for trout should not be merely "fishin'" with the value of the sport measured alone by the number of fish caught, but in the pursuit and capture of each individual fish when the angler has matched his skill, "fish knowledge" and

FIG. 78. Shadow Lake, a jewel of the Mount Lassen country, stocked with rainbow trout. Photograph by H. R. Basford.

patience against the wary trout, and the fish comes at last to the net, defeated; big indeed is the man who, when his best efforts fail, can admire the trout for his beauty, courage, and cunning.

It is trout fishing that is probably the greatest incentive for taking tourists up into the mountains and if this sport is to be continued it will require much serious consideration and work. Proper legislation giving the fish absolute protection during the spawning season and an increased output from the state fish hatcheries are prime requisites. Each year greater numbers of sportsmen advocate increasing the cost of the angling license to provide more revenue for carrying on the work of propagation, and since it is the angler who must supply this money, who has a greater right to initiate such a movement? Oregon has just increased her angling license fee to $3, and this added amount will permit the Oregon hatcheries and their output to be increased some 300 per cent. A license fee increased to $2 or $3 would enable California to hatch more trout and to give them better protection, but even with increased hatchery facilities the Fish and Game Commission alone cannot make a success of this work without the assistance of the sportsman, for he must help to keep sane laws on the statute books, discourage the *fish hog*, and cooperate in the enforcement of the fish and game laws.

TIMES HAVE CHANGED.

By J. D. Dondero, Deputy Fish and Game Commissioner.

As the population of California is increasing by leaps and bounds and the public lands are being taken up, it naturally follows that the open country for our game is becoming smaller and smaller each year. The use of automobiles, high-powered guns, improved highways and the ever-increasing habit of our people to get out of doors, are all important factors that are diminishing our fish and game and command our most serious consideration, as the fish and game of our state belong to the people.

A very large majority of the people obey the fish and game laws of the state and earnestly believe in conservation. When a person kills or destroys game out of season, he not only breaks the law but he actually steals this game from the rest of the people. Conditions have changed greatly in the last twenty-five years. People have been educated to realize the importance of conservation measures and where in the past

Fig. 79. Launch Freda, used by Fish and Game Commission in patroling Clear Lake, with load of illegal nets.

violations were treated lightly, I find the more progressive citizens now to be those who respect the fish and game laws.

After a personal survey of the game laws in force in the various states of this country, I find that California has game laws equal to if not better than any in America. We should never advocate any plan tending to commercialize game as this means its destruction.

It is my observation that the deer in this state are holding their own, due in a very great measure to the establishment of game refuges which have been created of late years by the Fish and Game Commission. I believe this to be one of the best achievements accomplished by the Commission, individual and press adverse criticisms to the contrary, notwithstanding. No better plan has been suggested by any of these critics for the conservation of our deer.

The Commission has also been unjustly criticised because certain parts of the game laws are not always evenly applicable to all sections of the state. The Commission has taken great pains to make the game laws and other regulations conflict as little as possible. One can readily see that too many districts with various seasons and laws would necessarily cause a great deal of confusion.

I believe in conservation by education, even having it taught more in our public schools. The great harm done by certain destructions of game should be impressed upon the minds of the young. For instance, the destruction of one female deer means that during a short period of five years, there are thirteen deer less than there would have been otherwise.

For a great many years, it was the custom of the people of this state to hunt in the mountains for the purpose of bringing back a quantity of "jerkey" or dried meat—making a regular slaughterhouse of our hunting grounds. That condition does not exist at this time, thanks to untiring efforts on the part of the Commission. The people of this country who hunt wild game do so nowadays as much for the purpose of getting out-door recreation as to secure meat.

Sporting clubs, gun clubs and protective clubs of various names are being formed all over the country—all with practically the same object in view, that of the conservation of fish and game and to take a more active interest in those matters pertaining to this important subject. The formation of these clubs is a splendid thing and they are doing a good work. They are not only doing good work in the conservation of fish and game but propose necessary legislation, recommend restocking of both fish and game, promote clean sportsmanship and stimulate good-fellowship among men and communities. These clubs are of great assistance to the game wardens in not only apprehending violators, but in greatly diminishing the number of violations. The very existence of these clubs has a splendid moral effect on the would-be law violator. They are not "Squealers' Clubs," as they are sometimes called but when properly functioning serve to *prohibit* violations. To keep game from being wilfully and unlawfully destroyed is worth much more to the people of this state than any prosecutions with their attendant fines, etc., could be after such game has been destroyed.

One of the things that should be discouraged is the raising of hounds for hunting deer. At the time when our bucks are at their prime during the open season, the fawns and young deer need the full protection of their mothers. Ordinarily a hound may run a mother doe a long distance from her young, thereby leaving the little fellows unprotected at night and an easy prey to the skulking coyotes, bob-cats and mountain lions.

If you are a good honest-to-goodness sport, you are the fellow who wants to give your game a fair chance, don't you? Well, try this. When you want to go out hunting deer, next time, take your machine and go to the buck country. Have your camp outfit and a good gun—leave old Fido at home. Get up at break of day, put a sandwich in your pocket, a small canteen of water on your back and light out. Outwit your old buck, and then when the day is over, and later you cast a glance at that noble head resting over your mantle recalling to your mind the thrill of that hunt, you can truthfully say, "I got him on the square."

Times have changed just the same in hunting as other thin
people are realizing more and more that the fish and game bel
the people and it is up to the people to take care of them if we
have any left at all. Remember the territory for hunting is grow
growing less, the army of hunters is rapidly growing la

greatest of care must be used by all to preserve the fish and game. During the great World War, in order to avoid a shortage of sugar, flour, etc., our government placed a limit on these articles and we got through all right. Why not apply the same rule to our fish and game—cut down the limits—kill less—save some for the next year and the year after that and so on. We can get the same old invigorating out-door trip with a smaller bag of game and leave some for the next fellow. The inducements for the out-door trip to thousands of people would be missing if there be no fish or game within their reach.

CONSERVATION THROUGH EDUCATION.

By WALTER B. SELLMER, Deputy Fish and Game Commissioner.

Since the dawn of California's history fish and game have played a picturesque and important part in her adventurous and romantic life. It is to protect from extinction the hundreds of varied species of this wild life which forms such a valuable asset to our great California and at the same time give to the sportsmen the greatest possible measure of liberty that the Fish and Game Commission has assigned its game wardens to various parts of the state.

While it is the duty of the game wardens to apprehend the violator of the state's laws for the protection of game and obtain the evidence to convict him, it should not be forgotten that the prevention of the crime is always to be preferred. The conviction of a violator does not replace the life that has been taken. It is merely a means whereby the

FIG. 80. Searching automobilists for illegal fish and game at Sausalito Ferry, Marin County. Photograph by W. B. Sellmer.

guilty may be punished and a warning to those who would consider the game laws lightly, or the penalties involved in their violation.

The real problem of conservation can therefore be dealt with adequately only when viewed from the standpoint of the prevention of law breaking in regard to the fish and game regulations of the state.

The real game warden does not consider his duty fulfilled when he flashes his star, arrests the violator and confiscates the unlawfully killed game. He realizes that his own efficiency is reflected in the number of violations that take place in his territory, and he endeavors to keep the number down to a minimum.

The price he must pay for this is eternal vigilance. It consists of preaching conservation; of educating the public in his territory what to shoot, when to shoot and how to shoot—or fish, as the case may be—by bringing home to the minds of the sportsmen that the game laws are actually enacted for their good; and by rigid enforcement of the laws so that those who may scoff at these arguments will nevertheless be prevented from breaking the law through fear of arrest and heavy fine.

I have always been a firm believer in conservation through education, in rigid law enforcement with heavy fines for violators, and in the cultivation of public support of the law.

When I took charge of the territory comprising Marin county three years ago the country was badly run down. It was nothing unusual to make several arrests a day. All this meant work for me and plenty of it. During the three years since then I have operated, holding in mind the principles that I have above set forth. And witness the result:

I have gained the confidence of the public and now sometimes as much as a week goes by without a violation taking place.

The game is on the increase. In 1919 there were 215 deer killed. In 1920 the number rose to 250 and in 1921 a grand total of 300 deer were killed in the district.

I was asked the other day how many deputies I had, and I informed the party making the inquiry that there were 1000 storekeepers, ranchers, hotel men and traveling salesmen and that they were all my deputies. By this kind of cooperation I can run down every law violator.

In my opinion the game law violator never succeeds in life and this should form a strong argument for respecting the law. Do you know of a game violator who has ever made a success in life? I don't believe you do and you never will. He never gets ahead because he is always paying penalties, either to a judge or in some other way. The world is against him, including nature herself.

I would like to call to the minds of those engaged in game law enforcement the great assistance I have found in making public through the newspapers the arrests and fines which are imposed. This sets an example to others and I have found this assistance to be invaluable.

WINTER DEER RANGE IN GAME REFUGE ONE D.

By C. O. Fisher, Deputy Fish and Game Commissioner.

Practically all of the deer from the summer ranges on the heads of a portion of Coffee and Swift creeks, all of them from the heads of Stuarts Fork, Canyon, North Fork, and the South Fork of the Salmon, come off of these high granite ranges in the fall of the year and down onto the Trinity river, where most of them range from the first of November until the middle of May. The largest number range in a small section of country along the Trinity river from Junction City to

Fig. 81. Appearance of buck brush as result of overstocking of Game Refuge 1D. Photograph by C. O. Fisher.

Fig. 82. Manzanita bush in Game Refuge 1D, browsed clean by cattle and deer. It takes starved animals to be interested in manzanita as forage. Photograph by C. O. Fisher.

Taylor's Flat, within game refuge 1 D. The snow in winter drives these deer into a section of country about five or six miles wide and about thirty miles in length, while in the summer they range over a section of country nearly ten times as large as their winter range. Deer have increased in numbers very rapidly in the refuge during the last few years, which complicates the matter of food supply.

This range in the refuge north of the Trinity river is at the present time overstocked with cattle, from which the United States Forest Service receives about 75 cents a head per year for the grazing privilege. During the past two years drift stock have appeared in this section and

a great number of them have been allowed to run there in the winter. The result is that the brush has been stripped of all of the tender tips that cattle and deer must live on during the winter for there is never any grass until the middle and sometimes the last of April. If you were out early in the morning where the deer are feeding in this refuge you could often see deer raise to the hind feet so as to reach a very few young tips from the brush. This scarcity of food has caused deer to eat the coarse brush and in some instances manzinita and madrone leaves which seems to weaken them so that during the last two winters many have died. This last winter in and near this section mentioned between thirty and forty head of cattle died of starvation, showing clearly that there is not enough feed for both deer and cattle.

During the past two years I have purchased at the expense of the Fish and Game Commission nearly a thousand pounds of salt, to use in salting the deer along the Trinity river, where they seem to be effected the most. This salt seems to help them a great deal and they certainly relish it. A standard of two pounds of salt to each head of stock is not lived up to here by the stockmen. The natural salt licks contain a large amount of arsenic which has its effect on them during the spring months. Most of the weak deer stay along the river section. These are the ones that are affected the most, for those that are higher up have a chance to get good brouse from the brush when the snows' weight flattens it down so that it is within the deer's reach. They also get a good deal of moss that the snow brings off of the trees when it is melting.

The number of lions are being reduced within the refuge by Bert Higgins and John Abbot, who hunt them at all seasons of the year. These men together kill from twenty to thirty lions every year.

BITS OF HISTORY OF TULARE LAKE FISHING.

By S. L. N. Ellis, Deputy Fish and Game Commissioner.

Permit me to refer you back some fifty-five years and more to a time when Tulare Lake had an estimated length of sixty-five miles and a width of forty-five miles, with the waters of Kern, Tule, White, Kaweah and Kings rivers all pouring into it. The vast plains of Tulare, Kern and Fresno counties were then a pasture and we had no Kings nor Madera counties. The settlements were confined to "timber belts" and favored spots in the foothills. The very few ditches for irrigation were confined also to the "timber belt" and were short and small and but little water was diverted from the main channels.

Tulare Lake and the streams mentioned were full of native fish and included the common suckers, Sacramento pike, Sacramento perch, "greasers" and several other fish belonging among the bait varieties. The Sacramento perch were usually dubbed "black perch" and the Sacramento pike generally called "lake trout." Few Sacramento perch ever left the lake proper but were found near the mouths of the various streams, where they congregated to get food that the streams carried to them. On the other hand, the suckers, "greasers" and "lake trout" left the lake annually in the spring high waters and travelled upstream for spawning purposes. It was then that the settlers went

fishing and usually armed with a spear that was commonly called a "gig," and hook and line. The Sacramento pike was generally gotten with hook and line baited with frogs, toads or minnows, but the suckers and greasers were taken with the spear. The early settlers were glad to get any of these fish and all were eaten and most thoroughly appreciated, for this was before the introduction of the black bass. The carp, catfish and salmon were then unknown south of the San Joaquin river waters.

I recall two favorable places for the taking of fish in the early days. One at the Dillon Mill, where a trap had been built by the mill operator in the water race which furnished the power to turn the wheels of the old time grist mill. This mill was about four miles from the present town of Exeter and got its water supply from the Kaweah river. The other was the Hard Pan Falls in the St. John's river, near the old townsite called Venice, between Klink and Exeter on the Southern Pacific Railroad. These falls caved in and fell during the flood of 1868 and no visible trace of them remains. Below the falls the fish would congregate in immense numbers and frequently the sight at this stopping place would be similar to looking at a flock of sheep crowded closely together, for the fish could not leap the falls. Many white settlers as well as hundred of Indians came to this place for their fish supply and usually were well rewarded with suckers and "greasers." A few settlers "salted down" a supply for future use while fish were easily gotten.

In the early seventies the "no fence law" was passed and the vast herds of cattle and horses that had grazed the plains were removed to favorable pastures in Arizona and Nevada. Following this came the settler—usually the small grain farmer—who began the opening up of agriculture lines which gave us our present conditions. Immense grain fields they were at first, but gradually cut smaller and smaller into the holdings of today. Immense irrigating canals and ditches were built and all flowing water was diverted from the main channels to supply the orchardist, vineyardist, dairyman and stock raiser. This diversion of water dried up the lower reaches of the streams, which in turn took away the supply of Tulare Lake, with the result that Tulare Lake is today a solid grainfield bounded and cross cut with immense levees and dredged channels. While this change of conditions was going on thousands of tons of fish were destroyed and lost, as there was no market for the common fish; while catfish and perch frequently sold at four cents per pound f. o. b., at some railroad station within shipping range.

Agriculture has claimed and taken away our former fishing conditions and we have but little water left for fish life within reach of the common people.

I have purposely left out trout conditions, for the trout belongs to the tourist and vacationist and not to the man who must do his fishing and return home the same day. There are still hundreds of fishermen who are content to get a mess of carp, pike, or suckers, and nearly any Sunday one can see these fishermen trying the overflow waters of the San Joaquin for the very fish that so many waste and leave on the banks to decay.

We can help these people by returning all fish not really wanted to the water, and by doing this we also relieve the strain on our better grade of fish, for every pound of common fish used relieves the strain on

the higher grades. The coming of the automobiles has added thousands to the ranks of the fishermen and unless we honestly and carefully do all that we can our fish supply will soon pass and fresh water fish will be a thing of the past, so far as the valley is concerned. Within the past decade, the writer has frequently seen discarded small catfish, pike and carp, also shad along the places where fishermen left them to rot. Dressed catfish are now worth 30 or 40 cents a pound in the Fresno markets. Carp sell on the streets at 8 and 10 cents per pound, and I have noticed San Joaquin river shad going east to New York by the car load, where they bring a good price. What excuse can any man have for wasting any of these fish? Now is the time for every fisherman to begin returning every fish not wanted by him to the water immediately, or give it to some one who is glad to get it.

CARELESS DEER HUNTING.

By F. A. BULLARD, Deputy Fish and Game Commissioner.

There should and must be some means of checking the careless hunter who invades our deer ranges and hunting grounds during the open season for taking and killing deer.

Under our present law for hunting and killing deer, there is no excuse at all for any hunter who wants to be law-abiding to shoot a human being or any domestic stock by mistaking them for deer. The law makes it plain that it is unlawful to kill any kind of a deer unless such deer has at least forked horns, and if all hunters will make sure that their deer is a *legal* deer before shooting no accidents will happen. Neither will he kill any does or spotted fawns as is quite often the case. These accidents—as they call them—can be blamed to two classes of hunters: First, the amateur hunter who never killed or hunted deer before, and goes into the woods thinking that everything that moves before him must be a deer. He sees a moving object, or sees the brush shaking, and without waiting to see if it is a deer, and one that would be a legal deer to shoot, he opens fire on it, at the same time so badly

FIG. 83. Doe killed by a careless hunter. The fawns were left to starve. Discovered and photographed by F. A. Bullard.

excited that everything looks like deer and deer horns to him, and only after it is too late to do any good, he finds out that he has shot a man—perhaps his hunting partner—or someone's cow or horse; or if it should chance to be a deer, it is not a legal deer to kill. And then he begins to patch up some hard luck story, of how he saw a big buck run into the brush, and just then this other object showed up and he thought it was the big buck he saw run in there and shot it. Last summer, in and around the General Grant National Park country, there were twelve head of cattle shot and killed, and the year before a like number. There was one man shot and wounded, and several more reported being shot at. And I found many does and fawns that had been shot and left where they fell.

A hunter near Sequoia Lake, Fresno County, shot the doe seen in picture, leaving her where she fell; two poor little fawns were left to starve or be eaten by the coyotes. One instance was called to the writer's attention last summer where a hunter, seeing the brush moving across the canyon from where he stood, took sight at the moving brush and was just in the act of shooting when a man poked his head up out of the brush. This hunter had his gun so near firing that he could scarcely keep from shooting after he discovered that it was a man he was shooting at.

The second class to which accidents may be blamed is what the writer would call the outlaw class. This hunter goes into the hunting grounds with his mind made up that he is going to kill the first deer he sees, buck or doe. He has no respect for the deer law, or any other laws of our country—county, state or national—and will shoot anything he sees if he thinks he is not being watched. Some of this class are good shots and seldom miss the target, and the writer believes them to be responsible for the large number of does and fawns left lying in the woods, merely shooting them to see them fall, and in many cases taking a chance shot in the brush, or taking a shot at long range where it would be impossible to tell a buck from a doe.

Many times I have seen hunters with deer antlers that would barely pass as legal antlers; and in many cases I have heard the hunter boast of what a long shot he made at the deer, where it would have been impossible at more than fifty yards to have seen the branch on the antlers.

As all of our deer ranges are in the mountains and largely in the national forests, the United States Government leases this range to the stock men to range their cattle on during the summer months, that they may market them in the fall of the year; the toll on cattle in these ranges by such hunters is getting to be so heavy that the cattle men can not stand it much longer; and just such hunters are gradually destroying our stock of deer.

FISH AND GAME HISTORY MADE AND IN THE MAKING IN SAN DIEGO COUNTY.

By Webb Toms, Deputy Fish and Game Commissioner

It was nineteen years ago the twentieth of July—after returning from the Philippines and receiving an honorable discharge—that I was appointed Deputy Fish and Game Commissioner.

I commenced work with the Commission by patrolling the country on a bicycle. The roads at that time were not much better than trails and it was a hard grind. The next method of travel was by horse and wagon, with the horse "broke to saddle." Then the autos began to come. I got the first "one-seater" coming here, and have had one motorcycle and six autos, and am now using a modern six-cylinder to keep up with the other fellow.

Fig. 84. Rescuing trout from tributary of Cuyamaca Lake, San Diego County, to improve sport in lake.

In this time I have made a little over three hundred cases for violations of our game laws, and lost sixteen of them; and have turned in $6,500 in fines.

Thirty years ago, before there were any laws on quail hunting, market hunters here shipped quail by the hundreds of dozens at a time. Martinis Chick, who at one time was champion wing shot of California, tells me he has shipped quail by the gunny sack full; and in the territory where he did his hunting there is scarcely a quail to be found. I have seen quail in flocks of five hundred birds and plenty of flocks, where today they are about all gone. San Diego was at one time rated the best quail county in the state. There is plenty of good wild country here but the quail, to survive, must have better protection. The open season should be all of December and a limit of ten birds. In my opinion the roadrunner is the worst enemy of quail.

There have been more band-tailed pigeons in San Diego County this year than for several years past. The oak mast was heavy and there was plenty of feed. The heavy snows of last winter drove the pigeons down to the lower hills where there was a good mast from brush oaks upon which the birds fed. If there is a failure of the mast, the pigeons seem to migrate. Some complaint was made of depredations in grain fields last year.

There were over one hundred deer killed in San Diego County last year. This means extermination. As the law is now, at the opening of the season the bucks are with the does, and every man who hunts deer knows what that means—easy to get a buck and the meat not fit for food. There must be a change in the deer law; the open season should be from August 15th (then they are about out of the velvet) to September 15th, and a limit of one buck. The rest of the deer law is all right.

With a liberal supply of trout furnished by the State Fish and Game Commission, San Diego County has started four trout lakes. Cuyamaca Lake has proved a success, and Lower Otay Lake is furnishing two-pound trout this season, as is also Hodges Lake. Barretts Lake was planted only last year. If these last named lakes are as successful as Cuyamaca Lake, San Diego County in two years more will have some very good lake fishing. The picture with net (Fig. 84) shows the forcing back into Cuyamaca Lake, of trout that have spawned in Cuyamaca Creek. The fish did not seem to get back into the lake as they should, and the day before the opening of the trout season, enthusiastic members of our just organized San Diego Fish and Game Association assembled at the creek and we put the fish in the lake. Over two hundred big trout were saved and put back for the lake fishing. If left in the creek, the fish could have been easily taken.

I have talked with sportsmen from the eastern states and they say there is more game there now than there ever was and that it is increasing. Why? Proper laws. I have talked with sportsmen from all parts of California and they say our game is going fast. I know that applies to San Diego County. California has plenty of game country from one end to the other and should have plenty of game. There should be a Fish and Game Protective Association in every county in the state—this to help the Fish and Game Commission to protect what game we have and to get proper laws through the legislature. If the sportsmen of California expect to have resident game much longer, they must wake up before the next session of our legislature, or it won't be long before they can put their guns away—as far as resident game goes.

THE AUTOMOBILE "CONCEALED WEAPON."

By S. J. CARPENTER, Deputy Fish and Game Commissioner.

We find from year to year, as time goes on, more fishermen and hunters, more automobiles, more roads built into the mountains.

When the fishing season opens, I find that two-thirds of the automobile fishing parties have firearms of some kind, and big enough to kill rabbits, quail, doves, and cripple or kill a deer. Two or three parties who believe in the protection of game, reported to me last spring that they saw deer crippled and found them dead from gun-shot

wounds; also found dove and quail killed by parties riding along the mountain roads in automobiles.

The only thing that can stop this wanton waste and destruction of the game is to pass a law at the next session of the state legislature making it a misdemeanor for any person to have in possession any kind of gun, pistol or fire-arm, of any size caliber, in any closed district.

We have a law at this time prohibiting shooting from automobiles, but it does not stop the violations as it would if it was unlawful to have firearms *in possession* in closed districts. This law would not affect anyone but the game violator and the stock man, and permits could be issued to the stock man and other parties who were deserving. I have looked through many automobiles and found a small-caliber shot gun or .22-caliber rifle in most of them, the excuse given being that they have it along to shoot jackrabbits or to shoot at targets. Often they give no lawful reason for having it, saying "it is too small to kill a deer," and "they just brought it along."

A law prohibiting any kind of firearm in closed districts would naturally cause quite an objection by those who desire to continue the practice referred to, and no doubt a great many people would oppose it; but it is necessary that something be done to check the use of fire-arms in closed seasons by the fishing and automobile parties who travel in the mountains, from the time the trout season opens until the deer season closes.

I have noticed, traveling along any of the roads where we have quail and deer, that before the trout season opens the game is very gentle and pays scarcely any attention to automobiles, but a very few days after the trout season opens they are not to be seen, unless it is a crippled one, too sick to get out of sight.

The reader may say, "why don't the wardens catch these violators?" To apprehend all of these violators, with the number of machines on the road at this season of the year, is almost impossible, and, too, if the officer was not on the spot at the time of the violation he can do nothing. In this last statement can be seen one objection to the small-bore gun—it does not make noise enough to be heard a very long distance, and the violator knows there is slight chance of the sound reaching the ear of a game warden.

I think every true sportsman will agree with me as to the soundness of this argument for the enactment of a measure that will do away with this particular form of violation of our game laws.

TROUT CONSERVATION.

By D. E. Roberts, Deputy Fish and Game Commissioner.

The matter of keeping the trout streams of California stocked to withstand the heavy drain they are now and will be subjected to, is becoming a serious matter with the fishing fraternity.

There is no question that the increasing number of automobiles, from year to year, which necessarily means an increase in the number of fishermen and fisherwomen, is the main reason for the heavy toll on trout as well as game.

Dry years and increased irrigation causes the drying up of small tributaries and gulches, which results in a considerable loss in spite of the efforts of wardens and public spirited citizens to save as many as they can by transferring the fish to living waters.

While I personally prefer fly fishing, I do not object to bait fishing, but I do object to the size of the hooks used. I believe salmon eggs should, and some day will, be prohibited. Their use almost necessarily means using a small hook, which a very small trout—often not more than three inches in length—can easily take. Whether small trout are like growing children, always hungry, it is a well known fact to any trout fisherman that the small fry are always ready for anything that looks good to eat, while the larger ones are laying off between meals. A limit of twenty-five, caught on many of our streams, with salmon eggs, would not make a meal for one hungry man, while on the same stream, the same number caught on a fly, (especially if you do not use a midget), or angle worms, or grub worms, would average much better. Some fishermen will contend they take the smaller ones off and put them back in the stream. Granted, but the way I have seen a good many take them off, they had better keep them or kill them and be done.

What we would lose one season by leaving many of the small fry to go over, would return us two-fold next year. I do not wish to be understood as criticising any particular kind of bait or fisherman, except as to the extent and method of taking the fingerlings.

A due regard for present sport, as well as for those who will be coming after, is necessary. A day astream with a dozen or two fair sized trout is more satisfaction than a limit of small ones; and the satisfaction in the knowledge that there are plenty left for yourself or some one else at a future trip should appeal to every true sportsman.

FIG. 85. Deputy D. E. Roberts patroling Tuolumne County.

GAME CONSERVATION IN TRINITY COUNTY.

By G. O. Laws, Deputy Fish and Game Commissioner.

The major part of Trinity County is enclosed within the national forests, including Fish and Game District 1 D, commonly known as Goat Mountain. This shelter was created in 1915, the result of a petition from the people of Trinity County, addressed to Frank M. Newbert, president of the California Fish and Game Commission, and presented by him to the state legislature for ratification. In circulating the petition, five only refused to sign it, showing that the people in general favored conservation. Of course the refuge was considered an imposition by many who were anxious to kill deer in and out of season, but sentiment has now changed among this class to such an extent that many are now requesting that a second refuge be established or that this one be enlarged. People have awakened to the fact that enforcement of the game laws is not oppression but simply conservation.

At no time has the shelter been seriously encroached upon by violators, and during the hunting and fire seasons, July 1 to November 1, it is strongly guarded. The lookouts on Bally Mountain report immediately to the nearest ranger or the main office at Weaverville, every shot that comes to their hearing. Trinity County has eleven regular deputies the year round: two state and nine forest officials and thirty four-months deputies, making forty-one during the hunting and fire season.

The relation between the forest officials and the fish and game deputies has always been most cordial and this cooperation greatly aids in law enforcement.

While the law governing 1 D is stringent, it deals without favor to anyone. Permits to carry firearms through the shelter, on public roads, must be obtained; also permits to trap fur-bearing animals. First a license, then a permit, if application is approved. Deer meat transported through, must be certified to before a notary public, as all game shelters are classified as closed districts.

The predatory animal hunters of 1 D are John Abbot of Hayfork and Bert Higgins of Helena. They are restricted to panthers, bobcats and coyotes, many of these animals being caught by them each year. No bear are allowed killed at any time within the limits of the refuge.

Salting deer on Bally Mountain, 7000 feet above sea level, has been tried out for the past five years. An increase in the number of deer around the salt logs has been apparent as a result of canvass taken.

Cattle and horses are allowed to graze in 1 D. Close observation shows that, as it stands now, feed conditions toward fall are not enough for all, and if it could be done, game shelters should be what the name implies—for wild animal life only. Deer require different kinds of feed during different seasons of the year; they eat a little grain in the early spring, but are a browsing animal and dainty in their habits. In browsing they pick each leaf separately and contents of stomach shows very few twigs. Deer use their lips for leaf gathering, while cattle use their tongues, and horses bite directly with their teeth.

This refuge is getting to be a show place and the residents of the county are proud of it. The state highway from Helena to Big Bar inside the refuge and hundreds of deer gather in this section for

winter—in fact, many stay there the year round. Tourists are referred there for pictures and for close range observation—for deer are here to be seen feeding in a natural state, without fear of man.

Among other attractions is a mighty black bear with a white face, and as far as we know, he has for the last four years taken good care to live inside the lines and not far from his cave. People who have seen him say he will dress 700 or 800 pounds. Two white deer also make their home here. The high altitude of parts of the shelter makes it an ideal summer home for animals, the low portions along the Trinity and Hayfork rivers furnish a winter range. Hundreds of mountain quail nest around the lookout station and bushy hillsides.

Composing as large an area of brush and timber lands as it does, only four fires—one incendiary, two from electric storms and one from power lines—have occurred since the shelter was set aside in 1915. This shows when no camping by hunters is allowed, fires are certainly less.

Conservation of game does not mean what many seem to think it does. The game and fish belonging to the people—you, me and everybody. Not to one individual or favored class, as certain people would have you believe. The Fish and Game Commission simply enforces the laws made by the people through their representatives in the legislature, and the wardens must follow the law and instructions as entered in the statute books.

In District No. 1, two deer are allowed to anyone under certain conditions, for the sum of $1.00, and if put on a money basis, the deer should be worth $30,00. On the other hand, for recreation, health and sport no valuation can be placed. Tourists, campers, and all good sports are welcome to Trinity's fishing, hunting and recreation grounds for pure water, health and sport.

SEEKING EVIDENCE.

By M. S. CLARK, Deputy Fish and Game Commissioner

In my duties as a deputy of the Fish and Game Commission, I have found it necessary to deviate a little from my fixed rule of operation, in order to catch some wilful violator of the fish and game laws. That rule is never to place myself in a position of encouraging violations, such as talking of violations in a trivial manner when not known to the party addressed, or otherwise encouraging a man to go out and violate a law in order that I may arrest him. But I assisted in "pulling off" one trap which, I think, was justifiable, as the man we were after was a notorious violator.

Some five or six years ago we received a letter from Deputy Bert Miller, at Ukiah, informing us that there was 200 or 300 pounds of dried deer meat at Boonville for sale, and that he thought if we would send a strange man up there, he could arrange to get him in touch with the parties who had this meat for sale. Mr. Hunter, our assistant executive officer, thought I could fill the bill, so I arrived at Ukiah the next morning and went to a livery stable and hired a team of horses and a buggy for the trip to Boonville.

I had been over the road numerous times, but in order to trap our man I was compelled to play the part of a total stranger, anxious to look at a ranch for sale near Boonville; also to get a certain man to drive me

over and introduce me to the parties who had the dried meat. Mr. Miller had arranged for this certain man to be in or near the stable when I came in to hire the rig. I informed the stable man that I would have to have a driver as I was not acquainted. He turned to this man and, addressing him as "Less," asked him if he could go with me. He said: "sure."

We got under way. As we passed the Hotel Cecil, I saw Mr. Miller standing on the sidewalk with a broad smile on his face, "sizing" us up. This man "Less" started in by telling me his life's history, which did not interest me at all; so, when we got into the timber and hilly country, I started him on the subject nearest to my heart by asking him if there were any deer in the locality. He informed me that he had killed nine deer the year previous, which did me no good, as, if I had brought him up on his own statement, he would have acknowledged himself to be a liar. He informed me that there were two brothers at Boonville with some dried deer meat, which could be bought, just the information which I expected to get from him.

As we arrived in town, "Less" spied one of the brothers on the street. He stopped the rig and introduced me to the man and asked him for some of the jerkie. This brother informed us that he had sold the meat the day before to a party at Napa but would try to get some meat from a friend of his and would let us know that evening. We journeyed out to look over the ranch I was supposed to buy, and later called on a cousin of "Less's." I remained in the rig and "Less" went in the house to see the cousin, who was in bed with a broken leg.

"Less" came out in about thirty minutes, placed a small package on the seat and we drove back to Boonville. On arriving at the hotel, "Less" took the package in and came out again. We put the team away for the night, and went into the dining room for supper. We were served with two beautiful steaks of the choicest part of a deer. I began to think very rapidly. To take him in would be to spoil the purchase of the dried meat, for which I made the trip. If we ate the meat, the evidence for a conviction on "Less" later would be gone. So I took a gambler's chance and ate the meat, which was delicious. After we had finished, "Less" turned over a small bone on his plate and said, "If there is a game warden in the country who can tell that is a deer bone, I eat my hat." "The best laid plans of mice and men go astray," so when we met our party that evening, he informed us that he could not get any more dried deer meat.

On our return to Ukiah, I informed deputies Miller and Lea of what transpired. They got a search warrant and went to Boonville; got some deer meat from "Less's" cousin, fined him and found out when he had broken his leg.

He had killed this particular deer on the range and in putting it on his horse to bring it in, the horse got frightened and jumped, breaking the man's leg. Quite an expensive deer, I think. In the meantime, we got in touch on the telephone with deputy W. J. Moore, at Napa, who searched the house of the parties who had bought the dried jerkie at Boonville. He failed to find any evidence to convict.

A PATROLMAN'S VIEWS ON CONSERVATION.

By J. L. BUNDOCK, Deputy Fish and Game Commissioner.

In considering the conservation of wild game of our state from the viewpoint of a patrolman, I will take first the bunnies—both cottontail and brush rabbits. These innocent little animals come in for condemnation, for crop failures, and, in fact, for about everything that can not be blamed on something else.

I remember being called to Morago Valley to see the "great damage" that the rabbits had done to a farmer's crop. "Completely ruined" was his complaint. He took me over the field, pointing out the damage done. This is what I saw: One side of his field was bordered with a heavy growth of wild blackberries and poison oak, as well as other brush. For a space of ten or twelve feet there was no sign of grain. What else could you expect? The life of the soil was drawn to the wild brush. I asked to be shown where the rabbits had eaten the grain. He could not show me. I could see no sign of any grain ever having been planted there.

The chief desire of this farmer seemed to be to have a permit to shoot the "bunnies," so that he might invite his "city friends" out for a day's sport.

It is no uncommon request that we deputies receive, to secure permits for farmers to shoot rabbits out of season, claiming great damage is being done. The real reason for the request seems to be, not the damage being done, but a desire to break the law and entertain their friends—with the consent of the Commission.

The rabbits do eat a few vegetables—but why be so hard on them? Do they not have to have food in order to raise their young?

The quail, too, comes in for its share of imaginary damages. I have heard farmers (strange as it may seem) claim that they had "gone broke" on account of the ravages of the quail! Never is the reason given that it is their own poor management.

The deer is not exempt from these "calamity howlers," yet how often do we find the deer coming into the valleys—unless a very severe winter has forced them down from their mountain retreat.

One can readily see how long the game would last, were all requests for permits granted, not considering the vast tollage taken by the persistent violator.

I would advocate heavier fines for a first offense, with the second offense bringing a jail sentence, as the best means of conserving our game.

THE CONSERVATION OF DEER.

By HARRY N. BRITTAN, Deputy Fish and Game Commissioner.

During my three years' service in the employ of the California Fish and Game Commission, most of my work has been in the mountains comprising western Colusa, Glenn, Tehama, northern Lake and southern Mendocino counties, where the deer comprise our most numerous and noted game; and I can notice, from year to year, that the deer are increasing in most localities.

I have had the opportunity to talk with old settlers in some sections of the country where deer winter, and they tell me that some twenty

years ago, on these winter ranges, they had a hard time to kill meat enough to eat, and now, on those same ranges, during the winter one may see the deer grazing in countless herds.

This increase is due to the long, hard work of the Fish and Game Commission and its deputies.

The noted hide hunters that devastated our ranges of the buffalo, elk, and antelope were fast destroying our deer in the same manner, but now, through the strenuous efforts of untiring officers of the Commission, those days are gone.

I believe at this time the most dreaded enemy of the deer is the California lion, which thrives principally on them, but is being hunted hard by men with trained dogs and also by trappers. There have been some fifteen lions killed this last winter and spring on the east slope of the Summit Range in this section.

The coyote, also, is very destructive to the deer in the spring of the year, when the fawns are small; and in the winter, when the deer get very poor, they are an easy prey for either the coyote or wild cat. There have been about one hundred coyotes caught in this section this year, and wild cats too numerous to mention.

But now, with the acreage in the mountains that has been turned into game refuges, and the protection that the United States Forest Service is giving in stopping the burning of brush which affords a cover for the deer, they are bound to increase and the next generation to come is to enjoy the same pleasure that we do in hunting this wonderful animal when the season of the law allows.

But the last and most insidious enemy of the deer in the estimation of the deputy, is the nimrod who is classed as a doe-killer. What manner of man is he who, allowed the freedom of this great field of pleasure, will wilfuly go out and shoot down an old doe, and leave the little children of nature to starve, and go on his way, rejoicing to think that some deputy did not see him commit this cowardly act; or, maybe, he will go into camp and tell his comrades about seeing no bucks but lots of does and fawn, but never mention what he did; or perhaps his conversation will lead on to the game wardens and he will tell what he would do if he met one out some place alone; and maybe, by chance, he will meet one, and that violator—how quickly he will change, and he is so sheepish and scared that he can hardly tell his own name or find his license when the deputy asks him for it. The game wardens are always glad to break up the hunting party if need be and drag to justice this kind of man.

THE EASTERN BULLFROG IN CALIFORNIA.

By TRACY I. STORER.

(Contribution from the Museum of Vertebrate Zoology of the University of California.)

The importation and acclimatization of species of plants and animals in lands where they are not native is a subject which has claimed the attention of naturalists and others for a great many years. The colonization of new regions by people from the older long established countries of the earth has almost invariably been followed by efforts to introduce homeland species into the new territory. A notable history of such efforts in respect to one colonial area has just been published* and should be read by everyone interested in the subject. Such introductions in all lands have been mainly of species desirable for food or sport or thought to be useful in some phase of agriculture. Mammals, birds, fishes and plants have consequently been the forms most extensively exploited, though scarcely any group of animal or plant life has escaped attention in this connection. It is desirable, for purposes of future study, to record as accurately as possible the history of each experiment, whatever the outcome, whether or not the species gains a hold in its new location and whether it turns out to be beneficial or harmful to man's interests. And in the case of successful introductions the subsequent progress of the transplant should be recorded. It is with these various points in mind that the following admittedly fragmentary account of the introduction of the bullfrog into California is offered.

On July 12, 1922, Mr. Franc Thiel of Mission San Jose brought to the Museum of Vertebrate Zoology two adult frogs and four very large live tadpoles which he had secured in Sonoma Creek near El Verano, Sonoma County, California. Other frogs of the same species had been caught for food in the same vicinity during the current season. These, according to reports furnished Mr. Thiel by local residents, were "French frogs" (which, however, is the local name, throughout California, for any frog suitably large enough to be used as food) and had come from a stock "brought from France" some years previously, and introduced into a nearby reservoir. The reservoir had overflowed one winter and the frogs (or tadpoles) became distributed over the surrounding country where they are now living and thriving in numbers. Some boys who visited Boyes Hot Springs in late July this year told the writer of seeing many very big tadpoles which were then "changing into frogs."

The frogs and tadpoles proved not to be "French frogs" but the common bullfrog (*Rana catesbeiana*) of eastern North America. The adults are comparable in all respects with descriptions and with an adult specimen at hand from New Jersey. The tadpoles far exceeded in size those of any of our native California frogs. One specimen of the latter measured 135 mm. (5⅜ inches) in total length. The "tooth pattern" agrees with that shown for the larva of the bullfrog by Wright in his monograph on the Anura of Ithaca, New York (Carnegie Inst. publ. no. 197, 1914, pl. VIII). All of the big tadpoles had the webs and toes of

*The Naturalization of animals and plants in New Zealand. By Hon. George M. Thomson (Cambridge, at the University Press). 1922. x+1—607 pp.

the hind legs well developed and agreed with the form and size of the "two-year old" tadpole of the bullfrog in the eastern states. One of these tadpoles was kept alive by the writer in an outdoor aquarium; by August 21 it had well developed front legs; by September 7 it had completed its metamorphosis.

The writer visited Sonoma Valley on August 27, 1922, and found good and abundant evidence relating to the bullfrog. In pools along the course of Sonoma Creek opposite Agua Caliente tadpoles of this species were found in considerable numbers. These were of three distinct sizes. The largest measured about 5¼ inches in length. All had hind legs fully developed and the front legs had either appeared or were about to appear. These larvae would have changed into frogs within a few weeks at the longest. The second category comprised tadpoles about 2 inches in total length. These, although larger than the fully grown tadpoles of our native creek frog (*Rana boylii*) had no evidences of hind legs. The coloration of these two lots of tadpoles was essentially similar, an olive green upper surface marked with fine black dots and a whitish under surface with little or no iridescence. The third size consisted of tadpoles ½ to ⅝ inch in length. These were mostly black, with scattered yellow markings and with an angular bar of yellow crossing the back just behind the eyes. These three sizes of tadpoles correspond to the descriptions given by Wright (tom. cit., pp. 83-85) for the two-year old, one-year old and newly hatched tadpole of the bullfrog in the eastern states. Presumably they represent egg masses deposited in Sonoma Creek in 1920, 1921 and 1922, respectively.

Local informants told the writer that a stock of frogs had originally been brought in by Mr. Rudolph Spreckels and placed in a reservoir on his country place which is on the east slope of Sonoma Mountain above Sonoma Valley. A letter of inquiry to Mr. Spreckels brought the following information. In September, 1914, and June, 1915, he purchased from H. Goodman and Co., 400-414 Poydras Street, New Orleans, La., eleven dozen "Jumbo Frogs." Also in September, 1914, one dozen large frogs were purchased from C. W. Coombes, a frog merchant of South San Francisco, making a total purchase of twelve dozen frogs. These were all planted in a small lake on his place. This lake or reservoir was emptied during November, 1917, and frogs and tadpoles were allowed to run out a pipe leading from the lake. "Thousands of polly-wogs" are said to have gone into a small creek nearby. This creek leads down the slope of the mountain and joins Sonoma Creek. When seen by the writer on August 27, 1922, the creek was entirely dry, but like other intermittent creeks of the California foothills it doubtless carries a considerable volume of water during the winter months. From the stock carried down in 1917 has come the present population of Sonoma Creek.

A heavy drain is evidently already being laid on the frog population of Sonoma Creek for only two adults were noted by the writer in the several pools examined. Ordinarily the shores of water where frogs have recently metamorphosed are lined with young individuals, but such was not the case here. The explanation lies in the fact that already many persons have become aware of the presence of sizeable frogs in Sonoma Creek and the animals are being hunted for food. One resident

of the region had on his gatepost a sign "French frogs for sale." Upon inquiring about his supply I was shown two crudely constructed enclosures with small pools of water. In one of these there were about six large adult male bullfrogs (one of these was 7 inches in body length), while the other pen held about 300 recently metamorphosed individuals of the same species. These had been captured by two boys along the creek and an attempt was being made to "raise" the small frogs for market.

Upon relating the first part of this account to Mr. Edmund Jaeger of Riverside, and showing some of the material to him, he informed me that some of his high school students in biology had this year (1922) brought in some tadpoles of the same caliber. Upon his advice I wrote to one of his students, John Goheen, and shortly obtained three more living specimens of the bullfrog. The frogs in this southern California locality are to be found in a reservoir known as "Mockingbird Lake," situated southeast of the city of Riverside at the mouth of Mockingbird Canyon. There are frogs also in the Gage Canal which skirts the base of the foothills back of Riverside.

Mr. Jaeger stated further that in 1914 when he was a student at the Loma Linda College of Medical Evangelists his instructor in physiology, Dr. A. W. Truman, had on hand some frogs which had been imported from the eastern states. Correspondence with Dr. Truman elicited the fact that he had obtained a large number of frogs from Illinois and some from Louisiana during his years at Loma Linda. Mr. Jaeger stated that the stock of frogs was kept in a cement bottomed lath house on the grounds of the college. The people in the neighborhood complained of the loud noises which the frogs made. [This is indicative of the stock having been bullfrogs. Our local native species of frogs, and the frogs other than the bullfrog which are commonly imported into California for physiological work, are all rather weak voiced.—T. I. S.] The Gage Canal runs directly below the college site and thence for about seventeen miles along the foothills and crosses the mouth of Mockingbird Canyon. Mr. Jaeger makes the suggestion that some frogs from the above-mentioned enclosure probably escaped and made their way into the canal. These adults or some of their tadpoles were then carried down to the vicinity of Mockingbird Lake. In 1922 the school children at Riverside knew of tadpoles "which took two years to change into frogs," so the species must have been established there by 1920 if not earlier.

Still a third occurrence for the species within the state has come to the writer's attention. Mr. Richard Hunt of the Museum's staff recently told me that on April 25, 1920, he had heard "eastern bullfrogs" in Searsville Lake back of Stanford University. Correspondence with Professor G. F. Ferris of the Stanford faculty elicited the further information that the same heavy voices had been heard there by him. Professor J. O. Snyder wrote that some "very large tadpoles" had recently appeared in Lagunita, a smaller lake directly on the Stanford campus.

"Bullfrogs" of unknown species are established in Little Lake, Inyo County, southeast of the Sierra Nevada. These are stated to have been "brought over from France." Verbal descriptions of these frogs were given to Dr. Joseph Grinnell and Mr. Richard Hunt in 1918 and again

FIG. 86. Eastern Bullfrog. (*Rana catesbeiana* Shaw.) Adult male from El Verano, Sonoma County, California, two-thirds natural size.

to Dr. Grinnell in 1922 by Mr. W. W. Bramlette who owns most of the land around the lake. The reported size of the animals, the strength of their voices, and the nature of the egg mass suggest that the eastern bullfrog is the species in question; but efforts to secure material for accurate indentification have as yet been unavailing. This introduction is believed to have been made about 1915 or 1917.

The accompanying illustration gives a good idea of the appearance of the adult bullfrog. The companion picture is that of our largest

FIG. 87. California Red-legged Frog. (*Rana aurora draytonii* Baird and Girard.) Adult female from near Berkeley, California. Two-thirds natural size.

native frog, the California red-legged frog. Both are figured two-thirds natural size. The outstanding features by which the bullfrog may be distinguished from this and any of our other native frogs are the following:

1. Ear membrane conspicuous, equal to (females) or exceeding (males) the eye in diameter.
2. Low rounded ridge bounds the upper and hinder margins of ear membrane.
3. Back relatively smooth, no large "warts," and no lengthwise folds or ridges of skin.
4. General coloration above dark greenish olive, irregularly and obscurely marked with dark brown; under surface white, sometimes slightly mottled with yellow. No reddish coloration on body or legs.
5. Fourth toe of hind foot webbed clear to tip.

The features by which the tadpoles can be recognized are indicated briefly above, in the description of the material collected by the writer in Sonoma Valley.

The bullfrog is the largest species of North American frog. Old adults, according to Wright (Bureau of Fisheries document No. 888, 1920) may reach a length (head and body) of 8 inches. The present writer has seen a number of California specimens which measured over 6 inches and one which was 7 inches in length. At the time of changing from the tadpole stage into the adult form, the animal measures about 2 inches in length. This is larger than with any of our native frogs at metamorphosis, so far as known. After the two years in the larval stage the bullfrog (according to Wright, 1920, p. 37) requires four years to reach a length of about 4¾ inches; old adults of 7 or 8 inches in length probably require 7 or 8 years to attain such a size.

The native range of the eastern bullfrog extends from the Gulf coast to southern Canada, and from the Atlantic coast westward to the margin of the great plains. In this wide area considerable differences in climatic conditions are experienced, and this may be taken to indicate a considerable degree of adaptability on the part of the species. However, there is one essential requirement of the bullfrog, and that is permanent water. The two year development history of the larvae requires this. The adults are highly aquatic, never going far out on land and spending much of their time actually in the water. In their native haunts, sheltered pools of water containing stumps and brush, as for example old mill ponds, are favored by the frogs, though they live to some extent also along sluggish streams. Here in the west, water reservoirs and the deeper permanent pools of our foothill streams afford suitable environment.

The future history of the bullfrog in California will be watched with interest; the evident success of the transplants here described will doubtless lead to attempts to introduce the species into other localities in the state. Such efforts would be likely to meet with success, provided the attempt is made with due regard to the requirements of the species. The writer would be glad to be informed of any such transplants.

The bullfrog in its eastern haunts is known to partake of a wide variety of living things as food, including small frogs of its own or other species, tadpoles, small fish, insects, worms and at times even small

birds. Introduced into suitable waters here, it would probably levy toll on the several classes of animals just indicated. But what effect such transplants may have on the local fauna can not be forseen.

The preceding account may possibly fire some reader to think of establishing a "frog farm" and in anticipation of this the writer would give a few words of caution. There are difficulties aside from those mentioned in the frog story told by Owen Wister's "Virginian." The rearing of tadpoles is readily accomplished in a pond suitably stocked with aquatic plants, as the larvae live and grow on a vegetable diet. But when the tadpoles change into frogs their food habits also change. Thenceforth they take only living animal food. The problem of the "frog farmer" is to supply this food. Thus far no successful means of providing the necessary food has been developed. On one "frog farm" of which the writer has heard the cannibalistic tendencies of the adults were indulged to a limited extent and this provided the food necessary for growth. The larger frogs were allowed to eat some of the smaller ones and some of the tadpoles. But a general segregation in size had to be made in order to keep the stock from becoming solely of adult frogs.

Berkeley, California, September 18, 1922.

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A DEPUTIES' NUMBER.

The administration of fish and game resources is largely in the hands of deputies of the Fish and Game Commission, who are locally known as game wardens. These men are held responsible for law enforcement, fish planting, educational work and all matters pertaining to their particular district. There are approximately seventy such deputies in the state. As a rule the warden is known to the average citizen as an officer of the law only. That readers of the CALIFORNIA FISH AND GAME may have a better insight as to the attitude of mind held by these faithful servants of the state, we offer herewith a deputies' number, the contents of which is largely made up of articles and editorials submitted by the various deputies. A perusal of these articles should convince the most skeptical that the men who have been chosen for this sort of work have the right attitude on conservation matters, are sincere, have their work at heart, and are performing a splendid service. It should be remembered that these men are always on duty and frequently work both day and night. Salaries paid them are not large and their chief reward is in the knowledge that they are working to prevent the extermination of a great resource.

If you are a true sportsman and conservationist you will find in your game warden a friend; if you are a violator of fish and game laws, he is rightly your antagonist. We are hoping that this number will interest you in the game warden in your county, and that you will be led to respect the admirable qualities which make him an efficient warden.

THE DEPUTY OF THE FISH AND GAME COMMISSION.

The deputy of the Fish and Game Commission is your humble servant. He is deputized to enforce the fish and game laws and protect your interests in the sport of hunting and fishing. Cooperate with him; lend him a helping hand in making known to him cases where violations of fish and game laws are taking place. The cooperation of the sportsman with the deputies of the Fish and Game Commission will make the cause of protection of fish and game a grand success, and build up for you and your children that sport which you and your forefathers have enjoyed.

The Fish and Game Commission is endeavoring to teach the public to protect its fish and game assets by education, through its deputies, through motion pictures of wild life, CALIFORNIA FISH AND GAME, and publications of various sorts, all of which is bringing the people who fish and hunt closer to the Commission and the ultimate aim—suitable protection of fish and game.

A great many things have been brought to bear upon the condition and protection of our wild life: Civilization has come in. Lands have been settled. Nesting places and spawning ground for fish have been removed. The birds and wild game have moved back. The saw mills, with their modern machinery and logging equipment, have laid waste and destroyed acre upon acre of forest, once the natural protection and home of the birds and wild animals. Irrigating ditches and dams have destroyed the spawning grounds for fish, or stopped their progress up the streams. Not until the Fish and Game Commission recommended laws compelling property owners to screen irrigation ditches from the main stream, were the fish protected and not used for fertilizer in the fields. The laws also compel owners of dams to provide fishways, or ladders, n runarounds around dams, so that the fish can get up over dams to head waters to spawn. All of this is done to protect the people's pastime, the sport of fishing and hunting. In all of this work the deputy plays an important part for it is up to him to furnish the proper information.

Because the deputy asks you for your name and the number of your license, don't think that he is too officious—that he should show you how to catch fish, furnish you with bait or hook *in fashion*, or lead you to a good fishing stream or pool. His duty is to check up licenses and

limits, and see that there are no infractions of fish and game laws. A fair, gentlemanly question is always answered in like manner by deputies of Fish and Game Commission.

Treat the deputy of the Fish and Gome Commission as you would like to be treated. Don't brand him as a game violator—or game hog, simply because you hate a man who carries a star and is empowered to enforce the law. Meet the deputy on an equal footing as any other man with whom you come in contact. Be gentlemanly and the deputy will return to you the same respect. The Fish and Game Commission endeavors to have manly men to enforce the laws of the Commission, and when a deputy is found otherwise, the Commission declares a vacancy.—Jos. H. Sanders.

LEGISLATION NEEDED TO PROHIBIT USE OF LONG GUNS.

In the past few years the use of what is termed the "long gun," has been increasing in the duck marshes of the Sacramento Valley, where some men are still trying to make a precarious living by hunting for the market. The "long gun" is an automatic with an extension chamber, allowing the rapid firing of ten shots; in other words, it is a small machine gun. Naturally the resulting slaughter of game is to be compared with that of the machine gun during the past war. Large bore guns are prohibited by law, and certainly the use of an agent of destruction such as this should also be prohibited.—S. J. Carpenter.

TRUE SPORTSMANSHIP.

From time to time a report comes to a deputy of the Fish and Game Commission, during the open season on deer, that a doe or fawn or spike buck has been killed and "*let lay*" by some unknown hunter.

Unfortunately such unlawful killing has been done accidentally and the hunter has not the nerve to pick up his unlawful game, for fear of law enforcement. The game warden, on hearing such reports, makes a very thorough investigation, and in many cases is unable to apprehend the game violator.

A great deal could be accomplished toward the correction of this harmful practice through the education of the hunters along the lines of true sportsmanship. An appeal should be made to the hunters of our state, that should they accidentally kill a doe, fawn or spike buck while hunting, not to let it lie and rot for fear of being arrested for unlawful possession of game but to be a true sport, bring in the unlawful game, surrender it to the nearest game warden or duly authorized officer of the law and swear to an affidavit as to the true conditions under which this unlawful game was killed. Any judge or jury of men in our state, having the true facts of such an occurrence, would gladly take into consideration such facts and render justice to the law and to the defendant, and the meat of such game would not be wasted but would be donated by the State Fish and Game Commission to some charitable institution.

If such a procedure was followed, it would tend to humiliate the hunter, causing him to be more careful next time. The game would not be wasted. The law would be recognized and enforced. Lastly, it would show a cooperation between the true sportsman and the Fish and Game Commission, the result of which would be to the interest of all concerned.—Jos H. Sanders.

NEW POLICY ON FISH DISTRIBUTION ANNOUNCED.

One of the serious problems of the Fish and Game Commission is that connected with the enforcement of the law which provides for the screening of irrigation ditches. In many counties the Commission has made persistent efforts to prosecute violators of the law, but with poor success, owing to the attitude of the district attorney. In order to bring about better cooperation in the enforcement of this important law a new policy has been decided upon. Hereafter, the output from the hatcheries will be alloted to those counties which are enforcing the screen law, and those providing suitable protection for the fish planted in the streams. It seems only reasonable that this course be taken to prevent serious loss of the fish which are reared at considerable expense in the state hatcheries.

MAILING LIST FOR "CALIFORNIA FISH AND GAME" REMODELED.

Attention is hereby called to the fact that the entire mailing list of California Fish and Game is being checked over and all those who have not signed cards during the past year will be eliminated from the list.

Although the Commission is anxious that all those really interested receive the magazine, it is imperative that wrong addresses be righted and that those not interested enough to read the quarterly be dropped from the list.

A SUGGESTED SYSTEM FOR CONSERVING YOUNG TROUT.

The time is growing closer to hand when it will be necessary for the Fish and Game Commission to ask for the power, or to have laws passed, whereby every alternate trout stream shall be closed for one year. The year following, this closed trout stream could be opened and the stream that was open the year previous be closed. By such a system small trout of three to six inches, being caught this year, would have a chance to grow for another year. This would afford the fisherman larger fish for his limit and more sport in obtaining his catch. Too often a deputy inspecting shipments of trout to various parts of the state, finds, on opening up the shipment, a limit of twenty-five fish weighing only two or three pounds. The average fish of such a shipment is from three to six inches. If these trout could have protection and be allowed to grow for one year more, what sport would it be to the fisherman to catch such fish!—Jos. H. SANDERS.

DIFFERENT SPECIES OF VIOLATORS.

The field deputies become acquainted with many different kinds of violators of the game laws. Among them is the man who lives twenty miles or more from a butcher shop, has a large family and is hard up. He has some excuse for taking game, but not enough to break the law.

Next comes the city man who never saw a deer, and in open season kills a spike or a doe by mistake. Although he should be punished, he is to be pitied.

Then comes the game hog, who kills bucks and kills more than the limit. It would be a good thing to take his license away from him for a couple of years.

But what may be considered the worst violator—and we have a few in every town—is the fault-finder. He is too lazy to go hunting but he will sit around town and criticise and "knock" the game laws. When the game warden makes an arrest, if this fellow can get to the party arrested, he will do all in his power to get the defendant to stand a jury trial. And when he meets a game warden, he has a big tale of woe and he tells him how the game law is being violated, but never gives a tip, or any facts. He pretends to be a friend, but just as soon as his back is turned, he has his hammer out.

Conservation by education is all right, but a good club would be better for the last named species. He should be classed with the coyote.—J. D. DONDERO.

SAVE THE BABY TROUT.

While out trouting one many times comes across a pool in which are many real small trout. Look! Possibly next week this pool may be cut off from the main stream and these little trout have become land-locked; in a short time they die, due to no feed and fresh water. If you can make a little ditch with your foot or stock of wood, from the pool to the main stream, as the water subsides these little trout will move out to the main stream. This small assistance from every sportsman in California would mean much to good fishing and plenty for next season—JOS. H. SANDERS.

JUDGE CONVICTS MAN OF OWN PROFESSION.

Judge Jerome Barry of Broderick, Yolo County, believes in enforcing fish and game laws, as evidenced by a recent case in court, the defendant having been found in possession of sturgeon in closed season and offering it for sale. The defendant was a wholesale fish dealer and the justice of the peace, also a commercial fisherman. In fact it was necessary to wait for the justice of the peace to make a drift with his salmon net before he could be induced to try the defendant. The defendant entered a plea of guilty and was fined $20.00, the minimum fine. The justice of the peace sold his catch of salmon to defendant.—W. J. GREEN.

ALIENS AND HUNTING LICENSES.

The present law which places jack rabbits on the predatory list as not protected, has brought the alien, with his gun, into the field, in the closed season of the game, at the nesting and breeding season. It allows the alien to carry firearms without a permit or license.

A recent case before the police court divulged the fact that an alien took out a $1.00 hunting license, and when found with a concealed revolver in his possession by the police officer, tried to tell the officer, and later the judge, that he thought the state hunting license entitled him to carry a concealed revolver and parade the streets at night. He was fined $50.00 after giving battle to the police in the lower end of Sacramento city.

Numerous fines have ben obtained by prosecuting aliens who have purchased citizen's hunting licenses in the Sacramento district. Typical of the facts in many of these cases is the following. Recently a Greek, who gave the name of Harry H. Campbell, took out a $1.00

hunting license and claimed to be a citizen by parentage. On looking this fellow up, his name was found to be Chris Koropulopuski. Registered under the new alien law of the last session of the California legislature, he told the judge the reason he was not drafted in the war was because he had a wife and child. It was found out later on that this Greek registered during the war, in South Dakota, as an alien. He was fined $50.00 by the judge. A clean-up on such aliens is very much worth while.—W. J. GREEN.

ATTITUDE OF MOUNTAIN PEOPLE ON GAME CONSERVATION.

While performing my work of killing mountain lions, I am brought continually in contact with the mountain people who live in the deer country, and it is a pleasure to note the present attitude of these people in regard to game conservation.

A few years ago, deer of either sex were killed at all times of the year and a game warden was considered an unnecessary meddler. As a result, the deer in many places were almost exterminated. Today, by these same people, the game laws are generally respected and the game warden is a welcome visitor at any time of the year, in most of the mountain homes; usually, too, he has the cooperation of most of the people, who are proud to tell of the many deer that range on and around their ranches.

These people have seen the result of game protection, as many of them have told me that there are twenty deer today where there was one twenty years ago, and now they are very bitter in denunciation of the chronic violator. This changed sentiment is doubtless also the result of the educational work performed by such publications as CALIFORNIA FISH AND GAME, bulletins of the American Game Protective Association, and the sporting magazines and also largely to the personalities and effects of the game wardens and forest rangers.

During the past three years, I have met most of these mountain deputies and forest rangers and have had their cooperation in my work, and I have found them to be, in my opinion, sincere men of good judgment, who use their efforts and influence to prevent violations, whenever possible, by explaining the purpose and benefit of game law enforcement. I believe that to the method and personality of the deputy may be attributed to a large degree, the sentiment of the people in his district.—JAY C. BRUCE.

THE SMALL BOY AND THE ANGLER'S LICENSE.

The instances given in this article of violations of our "trout fishing law" by an element that has no regard for law, and the wiley methods taken to evade the law illustrate some situations which our present law does not cover.

I recall three different instances of recent date, where I have met with young lads fishing for trout before the season was open. One case was in Niles Canyon. A young boy about twelve years of age, was fishing. I watched a grown man approach the boy, bait his hook and retire a short distance away. The boy threw his line. I then walked up to the boy and asked, "What are you doing?" He answered, "Fishing." I told him the season for trout was not open and he must stop. Immediately the man came forward and told me the boy "Too young for license; you no can 'rest him."

Another time, on one of our good trout streams, I saw two men, one much smaller than the other. Gradually I worked my way nearer until I was close enough to see that one was a young boy. The boy had a fishing rod and a bag on the shoulder. The man in this instance, as in the other, baited the hook and removed the fish, walking away each time, then coming back as needed. I watched them for some time, then I approached and asked for his license. The man was immediately "on the job,"—"Leetle boy, he no need license, he just 'leven years old." I asked him for *his* license, telling him I had seen him bait the hook and remove the fish. He replied, "You no can 'rest me, you no see me fish."

One morning, in March last, on Fish Ranch Creek along the Tunnel road, at 6.30 a.m., I found a small boy fishing, using the famous "willow rod and twine string." He had four small trout. I told him to quit fishing and get away before the "rider" found him. Some two hours later, I found the same lad still fishing; this time he had eighteen trout, all sizes up to twelve inches in length. I was somewhat "peeved at him," and took his fish pole. The next day I called upon his parents. His mother said, "I no think eet hurt much for zee small boy to fish—he like fish verry much—one fren' tell heem no can 'rest heem."

I think if parents encourage the boys to fish, and enjoy the fish that the small boy catches, that it is only right that they be held responsible for their son's violation of the law.

The small boy catches as many fish as the sportsman, so why not a license for the small boy who fishes as well as for the small boy who hunts?—J. L. BUNDOCK.

LARGE PROPORTION OF VOTING POPULATION SECURE LICENSE.

Many guesses are made as to the proportionate number of persons sufficiently interested in fishing or hunting to take out licenses. Here are figures from Plumas County for 1921, which show what a large proportion of the population of this county are interested in fish and game. Hunting licenses sold in Plumas county, 1921, 829; fishing licenses sold in 1921, 889; total, 1718. The voting population of Plumas County as taken from register is 2284.

ANTELOPE HERD CAREFULLY PROTECTED.

The California Fish and Game Commission is taking an active interest in the herd of antelope still existing in Modoc County. This herd is really the only sizeable remnant of the former herds which ranged the plains of the state. In past years poaching by Oregon hunters has endangered the herd, as has also reduced food supply during severe winters. Four deputies of the Fish and Game Commission are now stationed within a radius of sixty miles and one man devotes most of his time in protecting the animals. During the past winter a considerable amount was spent in feeding the herd.

TROUT MUST HAVE CHANCE TO MATURE.

Continual complaint comes, especially from coastal streams, that fry planted the year before are continually caught by fishermen the following spring. The conservation of a supply of trout is dependent upon some of the fishes reaching maturity, plus the planting of fish from state hatcheries. Some means must be found for preventing the capture of small fish. The size limit law of several years ago has been discarded and now but two alternatives present themselves. Either by education anglers must be taught to leave the small fish in the stream or every stream stocked must be closed for a year or two to give the fish a chance to mature.

WESTERN ASSOCIATION OF GAME COMMISSIONERS WILL MEET IN SACRAMENTO.

The Western Association of State Game Commissioners has accepted the invitation of the California Fish and Game Commission to meet in Sacramento for a two-day session on December 4 and 5, 1922.

David H. Madsen, president of the organization, states that representatives from nine different states will be in attendance and that many matters of importance will be discussed. As in the meeting last year at Salt Lake City, round table discussion will be emphasized and the special problems of the western states will be considered. It is the intention of this association to make the needs of the western states felt in game conservation.

PUBLIC SHOOTING GROUND-GAME REFUGE BILL.

All sportsmen are watching with interest the progress of the Public Shooting Ground-Game Refuge Bill, (H. R. 5823), which is still before Congress. Late last spring, the House Committee on Agriculture amended the bill in such a way that all moneys collected would go into the general treasury, from which appropriations would be made to carry out the purposes of the bill. This did not meet with the approval of sportsmen, even though many assurances have been given that more money would thus be received by appropriation than was produced by the bill. The intention now is to demand the original provisions of the bill and to add amendments which will do away with the opposition from western states as to the provision which would endanger local control of fish and game.

LAW ENFORCEMENT.

The results of the clean-up of violators of the fish and game laws in the Sacramento Valley show a contrast to attempted prosecutions of, say, ten years ago. The cooperation of the judges at the present time plays an important part in he success of the Fish and Game Commission in making the fish and game laws respected. At one time last winter four violators could have been found in one county jail at one time. One of these men was given a sixty-day sentence and another one a one hundred-day sentence. A violator soon forgets about a small fine but he does not soon forget days spent in jail.

ELK MOVED.

Last spring about twenty elk, which were placed near Pacific Grove by the California Academy of Sciences several years ago, and which have been causing damage in dahlia gardens at this place were captured and moved by the Commission to the Hutchinson Ranch west of

Williams, Colusa county. Hunters have been kept out and the animals seem to be doing well. Four calves have been noted this summer.

One large bull elk apparently wandered away from the herd and took up its home on a ranch in Sonoma County, near Santa Rosa, where it was carefully watched by the owner. When the animal suddenly disappeared, an investigation was made and the animal was found shot through the head by some careless hunter. A reward has been offered by the owner of the ranch for the apprehension of the person killing this elk.

CAMPERS, A PROBLEM IN CALIFORNIA.

Game law enforcement in eastern states is a much easier matter than it is in California. It is soldom that campers are to be seen in the open, even during the summer. Most hunters and fishermen stay at some well known resort and consequently are more easily watched by the game wardens. In California, the number of campers in the mountain districts must nearly reach the million mark. They are scattered in every out-of-the-way district where a passable road is available. As our game wardens can not be everywhere at the same time, it is practically impossible to watch all these recreationists. From this standpoint alone, it is obvious that California should have a much larger proportion of game wardens than eastern states and yet this is not true. States with a much less area and with a smaller problem have twice as many deputies as the state of California.

FRY OUTPUT WILL BE LARGE.

Although conditions earlier in the season make the outlook for a successful output of trout fry from the state hatcheries look very dubious, the final outcome has exceeded expectations. Handicapped by heavy snows and freshets, the spawntakers at first secured few eggs, but later a splendid take was obtained. It is expected that when the last trout leave the hatcheries for new homes in the streams the total for the season wil be close to twenty-six million, the largest output of trout in many years.

Of special interest was the hatch of cutthroat trout, secured from eggs furnished by the United States Bureau of Fisheries. These cutthroat trout were secured especially for Humboldt County, where conditions favor the planting of this Rocky Mountain species.

STATE FAIR EXHIBIT.

As in past years, one of the distinct attractions at the State Fair at Sacramento in September was the exhibit made by the California Fish and Game Commission. On those days when the attendance was the greatest a count showed 1500 persons, per hour, viewing the exhibit. The panorama of the Sierras was remodeled this year in order to depict a spring scene. Beautiful green meadows and a meandering river, with snow-capped mountains in the distance replaced the old scene. The usual lighting effects, with the addition of a thunder storm, were utilized.

Aquaria contained the different species of trout and all fresh water fishes found in the Sacramento region. Golden trout from mountain lakes at an elevation of 10,000 feet, after a journey of nearly a thousand miles by pack train, truck and railroad, were on display. Baby trout just hatched from the eggs and baby salmon were to be seen in the small model hatchery. The department of education and publicity featured a baby mountain lion which had been caught by the state lion hunter, and some baby flying squirrels. A display of skins of fur bearing animals, display of the publications of the Commission, charts showing the food habits of birds, and framed pictures completed this part of the display.

Those who visit the State Fair can not help but be convinced of the extensive work being carried on by the Commission in caring for and conserving the fish and game resources of the state.

PREDATORY ANIMAL CONTROL ON SPRING VALLEY WATER COMPANY PROPERTY.

Predatory animal control by means of systematic trapping and a strict rule that prohibits hunting have made of the extensive watershed properties of the Spring Valley Water Company in San Mateo County a great game refuge.

The particular area in which trapping operations have been carried on, is the watershed of upper San Mateo Creek and Pilarcitos, lying to the west of Billbrae and Burlingame. It consists of open and wooded country, the latter clothed with firs, oaks, grease-woods and lilacs. Wild oats, hill and valley grasses grow in profusion. There is also alfilerilla and clover.

For years no hunting has been allowed in this, nor in the rest of the San Mateo watershed area, and deer have greatly increased in consequence. Quail, however, appear to have decreased to a very

marked extent, and it was to give additional protection to these and other ground-nesting birds that predatory animal control was instituted. The campaign has been carried on vigorously by the Water Company since 1912.

Trapping, some seasons, has extended over an area of 14¾ square miles. Last season it covered an area of 10¼ square miles. Trapping was done by employees of the company.

The accompanying photograph shows 68 of the 84 animals trapped during the season of 1921-22. Among the animals trapped were a number of feral domestic cats, a large number of opposums, also coyotes, coons, foxes, skunks, weasels, badgers and civet cats. The opposum has spread rapidly, and a total of 39 has been taken since its first appearance in 1918.

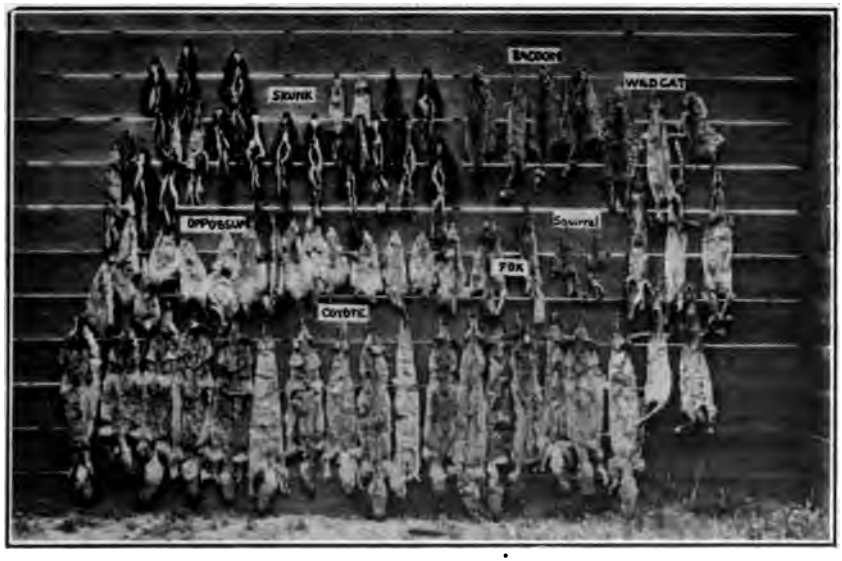

FIG. 88. Sixty-eight of the 84 animals trapped during season of 1921-22 on an area of about 10¼ square miles, on the San Francisco peninsula. Photograph by W. B. Lawrence.

The systematic trapping thus carried on constitutes an interesting experiment as to whether predatory animal control leads to a notable increase in game species.

Quail have decreased in number, so doubtless predatory animal control is but one factor in the problem, and there are doubtless others of importance that would be revealed by a more intensive study.

Spring Valley Water Company has always cooperated heartily with the Fish and Game Commission, and will be glad to continue the cooperation, not only along the lines already followed, but also in the solution of this puzzling problem as to why predatory animal control alone is not sufficient to cause an increase in quail.—W. B. LAWRENCE, Millbrae, Cal.

FINED FOR POSSESSION OF UNDERSIZED ABALONES.

On the 26th of January, 1922, Tony Ambra, an Italian of San Francisco, was arrested by Deputy John Burke near Point Pedro in San Mateo County, for having in his possession undersized abalones in violation of section 628*f* of the Penal Code. He was caught as he attempted to hide his illegal catch in his automobile. By actual measurement many of the abalones measured from two to three inches, whereas the minimum size limit is seven inches. The offender was taken before Judge Ray Griffin of Redwood City, who imposed a fine of $100.

DOVES ARE MIGRATORY BIRDS BY LAW.

Whether doves are protected by the federal law was tested during the year in the case of the *United States* vs. *Lumpkin* (276 Fed. 580) in the federal court for the Northern District of Georgia. The defendant, charged with

killing mourning doves during the federal closed season, contended that the doves killed by him were not migratory but had remained throughout the year in the state. The court held that the treaty between the United States and Great Britain for the protection of migratory birds declares that mourning doves are migratory, and the fact that an individual bird hunted or killed had remained the entire year within the state is no defense in a prosecution for a violation of the act of Congress to give effect to the treaty. The defendant was convicted and fined.

GAME AN IMPORTANT PART OF MENU ONLY FIFTEEN YEARS AGO.

Alaska and the Canadian Northwest has long been the mecca for big game hunters. Reports of the disappearance of game in these sections now come with alarming frequency. "The good old days" are fairly well described by the following menu which recently came to the hand of the editor:

FRIDAY APRIL 10, 1908

THE KING EDWARD CAFE
Dawson, Y. T., Canada

Short Orders at All Hours a Specialty

Soup
Clam chowder Bouillon

Fish
Boiled white fish, egg sauce ---- $0.75
Fresh Yukon greyling to order -- 1.00

Boiled
Brisket of veal with oysters ---- .75

Entrees
Calf moose cutlets with bacon -- .75
Roast beef hash, poached egg -- .75
Stewed beef and vegetables ---- .75
Fried eastern oysters on toast -- 1.00

Roasts
Prime rib beef au jus ---------- 1.00
Loin of pork, apple sauce ------ .75
Leg of caribou and jelly ------- .75
Fried eastern oysters on toast -- 1.00

Cold
Chicken, $1; Beef, $1; Ham ---- .75

Extras
Whole ptarmigan on toast ------ 1.25
Calf brains to order ---------- 1.00
Mountain sheep cutlets to order- 1.00
Arctic trout to order ---------- 1.00
Bear steak to order ------------ 1.00
Fresh greens, per order -------- .75
Fresh ranch eggs, each -------- .50

Dessert—Pudding
Assorted pies or cakes --------- .25
Tea Cows milk, 25c Coffee

HOW FAR DO BIRDS GO WHEN THEY FLY SOUTH?

The marking of migratory water-fowl, as practiced by the collaborators of the Biological Survey, United States Department of Agriculture, has given evidence that it will be a most interesting and important investigation. Although the work has been in progress for only two years, notable results have already been secured.

The ducks and other birds, whose movements are being studied by this method, are caught, mainly by the use of special traps, light aluminum bands placed on one leg and then released. Every band bears a serial number and the legend "Biol. Surv., Wash., D. C." In the Washington office of the Biological Survey, these banded birds are card indexed so that when a hunter secures a duck bearing one of these bands and reports the data connected with its capture, by referring to the card file, the route covered by the bird in question can be easily ascertained. When such records are received, the hunter is advised where the bird was banded, while the person who attached the band is informed where it was secured.

During the fall shooting seasons for the last few years, a large number of mallards and black ducks, with a few blue-winged teal and other species, have been banded at a small lake about twenty miles north of Toronto, Ontario, and many interesting returns have been received.

Long Range Record.

The best 'long range' record for these Canadian ducks is that of a blue-winged teal, banded September 24, 1920, and killed two months and seven days later, n the Caroni Swamp, near Port of Spain, on the Island of Trinidad, just off the coast of Venezuela. The shortest flight that this bird could have made would be over 3,000 miles. It is a well-known fact that blue-winged teals and certain other ducks that breed in North America spend the winter season in South America, but it was rather a surprise to learn that those individuals that had bred in Canada would make the long flight to South America, because the species also winters in small numbers in the Gulf region and it is to that area that the more northern birds might be expected to go.

The return records of ducks of other species, banded near Toronto, have afforded valuable data relative to their migration. The lake where the banding was done, Lake Scugog, is surrounded by marshes and thus offers excellent opportunities for the ducks to feed and rest before starting the long flight to the south. The trapping and banding was carried on continuously through the autumn, so that by the time the big southward movement began several hundred birds had been marked. At this time the season was open from the Great Lakes to the Gulf of

Mexico and the migrating birds had to run a veritable gauntlet of sportsmen. A large number of 'return records' were therefore received.

Mallards and Black Ducks.

In tracing the route of these birds it seemed apparent that the mallards and black ducks traveled together and their course from Lake Scugog was southwestward along the shores of Lake Erie by way of the St. Clair flats. Here the route divided, the majority continuing toward the southwest, crosscountry to the Ohio River, hence to the Mississippi Valley where many of them spent the winter. The second group, that parted from their fellows in the vicinity of Lake Erie, took a southeasterly route, crossing the Alleghenies and reaching the Atlantic coast by way of Chesapeake and Delaware bays. It is interesting to note that although both of these ducks are present and the black duck is plentiful along the coast of New England, none of the birds marked at Lake Scugog were taken in that region. The question that naturally arises is: Where do those ducks come from? So far we only know that some breed in that area, but we do not know just where the migrating birds come from that use that route. Bird banding will probably supply the answer when it has been applied more intensively at a larger number of stations.

SHELL FISH RESOURCES OF THE NORTHWEST.

Those who have been interested in the recent fish bulletin number 4, on "The Edible Clams, Mussels and Scallops of California" will find additional material along the same line in a recent publication of the Bureau of Fisheries (Document No. 920). The Bulletin is entitled "The Shellfish Resources of the Northwest Coast of the United States," by Charles H. Edmondson.

This bulletin is based on observations made by Mr. Edmondson in 1917-1919, in a survey by the United States Bureau of Fisheries, of the shellfish resources of the northwest coast of the United States including the shore line, bays, and rivers of the State of Oregon and the southern portion of Washington. First the more important shell fish centers, each with its own peculiar characterists, is discussed, and following these, consideration is given to the less important centers. The species of shellfish found in each region and their distribution, relative abundance, and importance are indicated. The report is splendidly illustrated with twenty-five plates showing photographs of some of the regions discussed and of the typical shellfish of the Northwest.

SUMMARY OF 1922 LAWS RELATING TO FUR ANIMALS READY.

The legislatures which met in eleven tates during the year made but few and unimportant changes in the laws relating to fur animals, according to the annual summary just issued by the United States Department of Agriculture, which, through its Bureau of Biological Survey, is charged with the administration of federal laws relating to the fur industry. Copies of the publication, entitled "Laws Relating to Fur Animals, 1922," by George A. Lawyer, chief United States game warden, and Frank L. Earnshaw, assistant, may be had by writing to the department at Washington, D. C.

In Alaska shooting of fur animals is now permitted, but beaver houses or runways may not be destroyed. Foxes certified as disease-free by an official veterin-.rian of another country may be imported vithout quarantine. In Montana a person suffering damage from beavers may get a permit to take these animals on his own premises, but skins so taken must be cared for, properly cured, and sent to the tate game warden for tagging. A special permit must be secured in order to ship he skin out of the state.

Evidence of illegal shipments of fur has been uncovered in the course of checking ıp shipments and receipts of furs by the principal fur houses of the country. These cases have been prosecuted and fines and penalties totalling several thousands of dollars imposed.

Not all states offer bounties for undesirable animals, although in most states where predatory creatures give trouble there is a price on the heads of wolves, mountain lions, bobcats, coyotes and simiar destructive animals. Sometimes the county or township pays the bounty. In Wisconsin the state treasurer duplicates all county awards. Seals are considered a pest in Massachusetts, as well as in the State of Washington. Anyone who can catch a panther in New York or California is entitled to $20 bounty. Bears in Pennslyvania have an open and closed season, although they may be kiled at any time in defense of person or property. American trappers receive yearly many millions of dollars for their fur harvest.

ELK HERDS NEED PROTECTION AND FORAGE DURING WINTER.

The estimated number of elk remaining in two large groups in the United States at the present time is only about 52,000, according to the Biological Survey of the United States Department of Agriculture. To insure the permanence of these splendid game animals, which are among the largest and finest of all deer, the cooperation and coordination of federal, state, and all other interested agencies is needed.

The elk of the Yellowstone Park region constitute the only really large herds of big game remaining in the United States, and although these number about 25,000, they are a mere remnant of the great herds which formerly ranged from Maine to California. The northern group, which ranges within the Yellowstone National Park in summer and migrates northward, suffered greatly from the adverse conditions of the winter of 1919-20.

The elk in the southern group are scattered in summer at high elevations in the southern part of Yellowstone Park, and in the mountains of the Teton, Bridger, Wyoming, and Washakie, National Forests. With the first heavy swonfall they descended to lower levels, where their winter range has become more and more restricted by the coming of settlers. Thousands of elk congregate in the path of their former migration in the vicinity of the winter refuge maintained by the Biological Survey at Jackson, Wyo. A winter feeding ground at this point attracts many elk, and it has been found necessary to furnish a supply of hay for them. Feeding is not recommended, however, where natural winter forage in sufficient quantity is available.

The other principal herds remaining on their native ranges are the Roosevelt elk, confined to the Olympic mountains in northwest Washington, and smaller isolated groups, mainly near the Pacific coast, which include the valley elk in a small area at the lower end of the San Joaquin Valley, California. If an elk is estimated to be worth $75, the value of the present herds in the United States would be approximately $4,000,000, which is a substantial national asset.

Within the past 10 years several thousand head of elk have been transferred from the Yellowstone Park region to localities in many states for restocking purposes. In Arizona, where conditions are suitable, these transplanted herds are thriving. In other districts it has been demonstrated that it is unwise to introduce elk on restricted areas near farming communities as more or less injury to crops occurs and claims for damages are to be expected.

The high mortality among elk in recent years has been due partly to weather conditions, such as periodical summer droughts followed by unusually severe winters, and partly to the encroachment of settlers, through whom much suitable winter range is eliminated. Hunters kill elk as game and many of the finest animals become victims of tooth-hunters operating illegally. Mountain lions, lynxes, wolves, and coyotes also kill many.

Adequate winter range, affording sufficient forage, and adequate winter protection must be provided if elk are to be maintained even in moderate numbers. In the opinion of the United States Department of Agriculture, limited areas of hay land urgently needed to supply forage for winter use should be purchased.

FACTS OF CURRENT INTEREST.

The 1922 output of trout from the state hatcheries will be near the twenty-six million mark.

The dove season just past has furnished plenty of sport to those interested in this bird; limit bags have been the rule.

Growing interest in conservation is resulting in the formation of many fish and game protective associations. More than a dozen active organizations of this kind are now to be found in the state.

Motion pictures of the spawning of salmon on the Klamath River will be taken this fall to be used in the educational work of the Commission.

The overflowing of several sections of grain land in the bed of Tulare Lake the past summer, and the subsequent pumping out of the water, has furnished splendid feeding ground for ducks and these birds have appeared in large numbers. Fortunately there has been no recurrence of the duck disease which decimated the ducks of this region in 1908-1913.

A reading of this magazine will show that still another non-native species has become acclimated in California. This time it is not a game mammal nor a game bird, but a game amphibian—the bullfrog. The bullfrog is actually hunted for food and for sport and so may properly be termed game.

The biennial report of the Fish and Game Commission now in preparation, will detail the accomplishments of the past two years. In law enforcement, hatchery output, educational activities, and in fact in all lines of endeavor, they have been banner years.

Fish are to be furnished hereafter to those counties which will properly care for them. Has your county proper fishways and proper screens at the intake of irrigation ditches? These are necessary precautions in the protection of trout fry.

COMMERCIAL FISHERY NOTES.

N. B. Scofield, Editor.

SALMON INVESTIGATION.

The salmon investigation which started four years ago with the marking of young salmon at the Mount Shasta Hatchery, is now showing developments of great interest. Dr. J. O. Snyder of Stanford University, in charge of the investigation, has spent the past three months in the field, aided by three assistants. Particular attention has been given to a search for returned marked salmon at the principal trolling districts, Monterey, Point Reyes, Fort Bragg and Eureka. A disappointing number of returns have been secured, but those taken have added interesting information as to the life history and distribution of the salmon. Last year twenty-three were secured; this year two were taken in Monterey Bay, two at Point Reyes, one at Fort Bragg, five at Eureka and only one at the place where the greater number were expected—on the lower Klamath. The results again indicate a wide distribution of the Klamath river salmon during its life in the ocean. It will be remembered that Sacramento salmon marked several years ago, were taken at Monterey, Pittsburg, and Shelter Cove, Mendocino County.

Results this year point to the possibility that the additional marked salmon to be secured this year, when the spawning season begins at the Fall Creek Hatchery on the Klamath, will be males, and that most of the marked females will return next year, five years after their liberation in the Klamath river. It seems reasonable to believe that holding the young salmon in ponds at Mount Shasta Hatchery might make them mature a year later than those reared naturally in the stream.

In recovering marked salmon, light is thrown on the movements of this valuable food fish in the sea, about which little has been known heretofore. From the practical side of fishery conservation, it will furnish evidence as to what streams are being drawn upon in the different trolling districts.

Extensive marking experiments will be carried on this fall on both the Sacramento and Klamath rivers, in order that still further facts in the life history of this species may be found and utilized in protective legislation.

MEXICO ATTEMPTS FISHERY CONSERVATION.

Professor Carlos Cuesta Terron has been placed in charge of the west coast fisheries by the Mexican government. With headquarters at San Diego, California, he will have a chance to study and plan proper protective legislation for the vast fisheries of the Lower California coast, and at the same time will have a chance to study American methods.

Professor Terron promises cooperation with the California Fish and Game Commission in its fishery conservation work and proposes uniform laws on fisheries in the two countries.

CANNERS WILL BE FORCED TO SECURE ACCURATE WEIGHT.

Because of the need for accurate weighing of fish received at the canneries so that the fishery statistics gathered may be correct and also in order that a careful check may be obtained of the amount of food fish sent to reduction plants the Department of Commercial Fisheries is planning supervision by the state sealer of weights and measurer. A meeting of canners looking toward the consummation of this plan was held at Monterey on September 21.

COMMERCIAL FISHING LAWS ENFORCED.

Fish and game deputies working in the San Pedro and San Diego districts under the department of Commercial Fisheries made 131 arrests between January 1, 1921, and July 1, 1922, for violations of the fish and game laws. Thirteen arrests were made for violations of the laws relating to spiny lobsters. Of these two were acquitted, two received suspended sentences, while the remaining nine paid fines totalling $300. Twenty-five arrests were made for violations of Sec. 628*e* of the Penal Code relating to surf fish, croakers, undersized halibut and barracuda. Convictions were obtained in each case and the fines totaled $1,685. Six arrests were made and convictions obtained under Sec. 628*f* of the Penal Code relating to abalones and clams. The fines amounted to $225. Eighteen arrests were made for violations of Sec. 636 of the Penal Code relating to net fishing. One of the eighteen was acquitted while nine received suspended sentences. The remaining eight paid fines totalling $1,100.

Three arrests were made and convictions obtained under Sec. 636½, a special section relating to paranzella and drag nets. Fines were collected amounting to $300. Four arrests were made for using nets within 750 feet of a pleasure pier. Of these two were dismissed and the other two paid fines to the amount of $100.

Sixty-two arrests were made for fishing without commercial fishing licenses and paid fines amounting to $660.

In addition to the fines aggregating $4,370, fourteen nets were seized and confiscated. The deputies also seized and distributed to state and charitable institutions, 271 pounds of abalone, 40,510 pounds of barracuda, 3500 pounds of croaker, 8559 pounds of halibut and 972 pounds of lobsters.

SALMON FISHERY IN DANGER.

The salmon catch in California this year has been so poor that most salmon fishermen and fish dealers are now convinced that the salmon have been overfished and that radical fishing restrictions must be adopted if we are to save the remnant of the run of this valuable fish. The efforts of the Fish and Game Commission during the past several years to restrict the catch have been opposed by both river and ocean fishermen as well as by some of the fish dealers. This opposition, aided by lobyists at Sacramento, has so far prevented proper legislation. If radical measures are not taken at the next meeting of the state legislature to further protect the salmon we are sure to see the same old story enacted again—of action being taken only after the species has become commercially extinct.

FEDERAL POWER COMMISSION DENIES PERMIT FOR KLAMATH DAM.

The Fish and Game Commission's fight to prevent the destruction of the Klamath river salmon run by the erection of impassable dams for the development of hydro-electric power has resulted in the Federal Power Commission denying the application of the Electro-Metals Company to build high dams on the lower Klamath river within the Klamath National Forest. The Electro-Metals Company proposed to develop electric power and transmit it to Trinidad on the Humboldt County coast and there use the power to smelt bauxite ore which they said they would bring from British Guiana.

The Fish and Game Commission protested against the granting of this permit contending that if dams of the height proposed are built on the lower Klamath river the salmon run on the river would be destroyed. It contended also that enough electric power can be generated from the water in the upper tributaries of the streams so that it is not necessary to destroy the salmon by putting insurmountable barriers where the salmon will be prevented from reaching their spawning grounds. It contended that the fish which enter the stream belong to the people of the state and that the people's proprietary right to the fish can not legally be taken from them. The comparative money value of the fish as compared with the power that would be developed should not enter into the discussion although it does constitute a large part of the arguments of power promoters and electrical engineers.

FUNDS INSUFFICIENT FOR SALMON CONSERVATION WORK.

With the growing scarcity of salmon the Fish and Game Commission's salmon conservation work has had to be increased. This has necessarily been accompanied by an increased expenditure of money along this line. There is a necessity for increasing the salmon hatchery work as well as a necessity for increasing the salmon investigation and patrol work. The state spends annually more than $25,000 in hatching salmon and the United States is spending a like amount in this state for the same purpose. The commission desires to increase this work. Added to the hatchery work there is the expense of the salmon patrol and investigation work which amounts to more than $20,000 each year. The Fish and Game Commission receives no appropriation for this work but must finance it out of the revenue from commercial fishing licenses and the very small amount received from the tax on salmon which are canned or salted. The entire amount received from all commercial licenses sold in northern California, together with the tax on salmon for canning and salting is not nearly sufficient to pay even the state's portion of the expense of salmon hatching to say nothing of the patrol and investigation work which are equally necessary. The bulk of the salmon which are caught are used in the fresh markets and the fish which are used in the fresh markets pay no tax for conservation work. It will be necessary in the fight to save the salmon to increase the revenue for conservation work in the districts where the salmon work is being done. Fish used in the fresh markets should be taxed to furnish a revenue sufficient to carry on this very necessary work.

STRIPED BASS DECREASING.

The annual commercial catch of striped bass in California shows a decrease of about 50 per cent since 1915, and along with this decrease in the commercial catch is a decided scarcity of bass in many of the haunts where both anglers and commercial fishermen formerly found them abundant. The present scarcity is most noticeable in most parts of San Pablo Bay and in the mouths of sloughs tributary to it. On the other hand striped bass are apparently more plentiful in some other places and good angling has been enjoyed in places where they had been caught only in very limited numbers before. There are some ardent striped bass anglers who believe that these fish are just as plentiful as they ever were. They believe that some of the sloughs have been fished out by anglers but that in most cases the bass have moved from their old haunts and have to be sought in other places. Commercial fishermen say that the bass are about as numerous as ever but that they have moved and that the best net fishing is to be found in places where the bass were formerly not so abundant.

Most bass anglers, however, are firmly of the opinion that the bass are not only less plentiful but that they are on the road to extermination. It is our belief after reviewing all the evidence that striped bass are not so plentiful and that they are being over fished at the present time. It should not be argued that the falling off of the commercial catch shows that the bass are being fished out by the nets and that there are less than half as many bass as in 1915. It is very much more likely that the 50 per cent decrease in the commercial catch is almost entirely due to the very good restrictive legislation which has been obtained through the efforts of the Fish and Game Commission and the commission's efficient enforcement of the protective laws.

The usual method of protecting fish against overfishing is to restrict the catch and when efficient protective measures are adopted and enforced the resulting decrease in the catch should not be used as evidence that the fish are being exterminated. The scarcity of bass in some of their old haunts about San Pablo Bay we believe is largely due to the bass moving to other regions. This movement is largely due to the pollution of San Pablo Bay waters by the Government's dredging operations about Mare Island and in deepening the channel from Mare Island to Pinole Point. Much dredging has also been done about the mouths of the more *important* sloughs. The continued stirring of the mud by dredging operations has caused the tides to carry great quantities of silt over the bay and into the mouths of the sloughs where it has settled to the bottom like a blanket and has pretty effectually killed the diatoms and other plant life which form the basis of the food supply of fishes. This condition was called to our attention by Dr. Albert Mann of the Carnegie Institution after he had made a diatom survey of San Francisco and San Pablo Bay waters. Dr. Mann was alarmed by the conditions he found in San Pablo Bay and stated that if we are to preserve our fisheries we will have to guard against the blotting out of diatom life by silt from dredging operations such as taking place in our bays and rivers. There can be no doubt that the pollution of the waters by sediment from the dredgers has caused the bass to largely abandon their old haunts about San Pablo Bay. Oil pollution may also be a contributing factor. The best evidence that striped bass are being depleted by fishing operations is the growing scarcity of large individuals. This is one of the surest signs of depletion and very nearly every one agrees that there are fewer large bass. Striped bass need more protection but protection is more urgently needed in the case of the salmon. As these two fish in the San Francisco Bay region are caught by the same fishing methods and are to a large extent caught at the same time in the nets it is necessary to protect both if we are to protect either, so striped bass and salmon protectionists are proposing to get together and aid the Fish and Game Commission in the better protection of the two fish.

BAIRD HATCHERY AGAIN OPEN.

For the first time in three years salmon eggs are being secured at the Baird Hatchery on the McCloud river, by the United States Bureau of Fisheries. By the middle of September 800,000 eggs had been secured and many ripe fish were being held for spawning. It will be remembered that salmon have failed to reach this station on the McCloud river during the past three years, owing to the Anderson-Cottonwood irrigation district's dam across the Sacramento River at Redding, over which there was no suitable fishladder. Injunction proceedings by the Fish and Game Commission last spring resulted in the remodeling of the dam to allow progress of the fish up the river. The high water in the stream has perhaps been most instrumental in the conditions existing this year, for additional work will probably be necessary to satisfactorily care for the migrating salmon at the dam.

CONSERVATION IN OTHER STATES.

NEW YORK PASSES ALIEN GUN LAW.

New York at its last legislature passed an alien gun law which lines this state up with Pennsylvania, long famous for its alien law. The provisions of the law require every man purchasing a hunting license to state where he was born, or, if foreign born, to produce his naturalization papers before a license can be issued to him. The bill provides further that it shall be unlawful for any unnaturalized foreign-born person resident in the United States, to hunt any wild bird or animal except under the special license issued directly by the Conservation Commission, and to that end it is made unlawful for any such person to own or possess a shot gun or rifle. The special license makes it possible to grant special permission to responsible persons. Provision is also made for the forfeiture of any gun held by an alien without a special license.

Such a law is helpful in many ways. It controls the hunter from the south of Europe, who is ready to shoot everything from a song bird to a deer out of season, and thus facilitates the warden's work, and it will doubtless reduce the number of murders, as it was shown to do in the state of Pennsylvania, by taking away weapons from dangerous characters. Furthermore, it will be an incentive for the alien to become a citizen, for sentiment is growing everywhere in favor of issuing licenses only to those sufficiently interested in this country to become citizens.

UNIQUE HUNTING LICENSE IN MAINE.

One of the most unique hunting license systems in the United States is to be found in the State of Maine, where it costs a resident but 25 cents for a hunting license which is good for life. The state collects but 10 cents out of the 25 cent license, the rest going to the seller of the license. The main income for fish and game administration comes from appropriations and from non-resident license fees.

LOWER CALIFORNIA HAS NEW GAME REGULATIONS.

In the northern district of Lower California new regulations adopted by the present governor fix the period September 1 to February 28 as the open season for hunting game and require separate licenses (fees $10 each) for large and small game; the females and young of deer, antelope, and mountain sheep are protected at all times; the daily limits on deer are 4; antelope, 2; sheep, 2; ducks, 40, and quail, 50.

ALBERTA REDUCES LIMIT ON SHEEP AND GOATS.

Alberta has reduced the limit on mountain sheep and on goats from 2 to 1 each a season, and has provided that the holder of a general license, upon obtaining a special license (fees, nonresident, $25; resident, $2.50), may hunt deer, moose, and caribou in the Rocky Mountain forest reserves of the Province during September and October.

MARYLAND CLOSES SEASON ON DEER.

The close season for deer has been continued in Maryland until 1926, after which the open season will be from November 10 to November 20, and the limit one buck with horns not less than 4 inches long. A fixed penalty of $300 or 90 days in jail, or both, is prescribed for the illegal killing of deer in the state.

MISSISSIPPI'S NEW GAME LAW.

The provisions of the new game law of Mississippi relating to migratory birds practically conform to the federal law and regulations but no provision becomes effective in any county until adopted by its board of supervisors.

INVESTIGATION OF ALASKA PENINSULA FISHERIES RESERVATION.

Dr. Charles H. Gilbert, of Stanford University accompanied by Willis H. Rich and W. P. Studdert, this past summer made a thorough investigation of the Alaska Peninsula Fisheries Reservation to determine whether the present regulations are adequate to keep the fisheries of that district in perpetuity. They investigated the spawning beds, marked many fish with metal tags to determine whether the fish are local in their origin or are merely a body of fish moving through that district to other sections. Upon these investigations will be determined the character of future regulations for the reservation.

FOOD OF PELICAN TO BE INVESTIGATED.

Dr. Henry B. Ward, of the University of Illinois, Urbana, Ill., has been employed to conduct investigations of the pelican in relation to the fishes of Yellowstone National Park, with the view of ascertaining to what extent these birds prey upon the fish and whether or not they serve as hosts for the parasite which infests many of the trout of the park waters.

CARP PROPAGATION IN OHIO.

At the earnest solicitation of the commercial fishermen, the United States Bureau of Fisheries again undertook carp propagation last spring for the third consecutive year at points on the Portage river, near Port Clinton, Ohio. The efforts to obtain ripe eggs met with unusual success, upwards of 92,000,000 being secured for artificial incubation between May 24 and June 24. The fry resulting from these eggs will be liberated on the local spawning areas.

GAME REFUGES TO BE ESTABLISHED IN NEW YORK.

The Conservation Commission of New York is authorized to set aside 100,000 acres of state-owned lands in the Adirondack Park as game refuges, but no area can be so set aside without the approval of the board of supervisors of the county in which it is located.

LIFE HISTORY NOTES.

OPOSSUMS INCREASE IN TULARE COUNTY.

There have been two or three opossums (*Didelphis virginiana*) caught in the Tule river country, east of Porterville, and one was recently caught further south in the Kern river country. A number of years ago Dr. Hardenman of Porterville secured several opossums and turned them loose in the South Tule region. No doubt these are the offspring of the ones turned loose. One was on display in the windows of the Porterville Chamber of Commerce last winter and is now in captivity in the city park.—FRANK P. CUNNINGHAM, Porterville, California.

TROUT GROW LARGE IN LAKE TAHOE.

Lake Tahoe has long been famous for its splendid lake fish. The trout most commonly caught is a variety of cut throat known as the black spotted or Tahoe trout. Large ones, like the one in the accompanying photograph, are sometimes taken. The picture shows Mr. Lorentz holding a fourteen and a half pound black-spotted trout (*Salmo henshawi*), caught near McKinney's during June, 1922.—JOS SAUNDERS, Truckee, California.

FOUR-POINT BUCKS NUMEROUS IN TRINITY COUNTY.

It is becoming more and more important to keep accurate statistics regarding the deer killed in order that scientific

FIG. 89. A sizable black-spotted trout in Lake Tahoe near McKinney's; weight 14½ pounds. Photograph by Jos. Saunders.

data may be available to demonstrate exactly the number of deer that may safely be taken each year without impairing the breeding stock. A careful check of the black-tailed deer killed in my part of Trinity County during 1921, segregated according to the size of the buck, should prove of value in this connection.

Number of five-point bucks	5
Number of four-point bucks	24
Number of three-point bucks	18
Number of forked horn bucks	12
Number of bucks unspecified	60
Number of deer found dead	34
Total	153

There were four horses and sixteen head of cattle shot for deer in Trinity County during the hunting season, and two fatal hunting acidents.—C. O. FISHER, Helena, California.

DOES THE MOUNTAIN LION SCREAM?

Does the mountain lion scream? So far as my experience goes I must say no. The grounds upon which I base my opinion are that I have never been able to connect the mountain lion with any screams I have ever heard in the woods.

For a number of years I believed the mountain lion gave screams and hoots, simply because so many old timers told me they did, but on two or three occasions I followed up the sounds and found the mountain lion did not make them.

When I was a boy growing up an old man lived near us, who came to these parts in the fifties and followed hunting all his life. He claimed to have killed thirty lions, anyway I knew of his killing five or six, and at different times when we were out hunting together, upon hearing these screams, he would say, "Now that is a mountain lion," which he believed to be so. But since, I have followed up the same screams and found them to be made by owls. I myself have never heard the mountain lion make any noise other than a coarse cat-like growling and snarling when angered by dogs.—L. S. DAVEY, Usona, Mariposa County, California.

AN EARLY FLIGHT OF DUCKS.

For several years I have noted a distinct flight of pintailed ducks which arrive in Colusa County from the 1st to the 10th of August. During the day time they feed by thousands in the grain fields, loafing during the middle of the day on the sloughs. Ducks were late in leaving last spring and I had expected that they would be late in arriving this year, but on August 5th they were to be seen by the thousands. Where do they come from? Certainly they are not local birds. Some maintain that this is the first flight of birds from the north and part of a distinct coastal flight. I am inclined to the theory that they may arrive from further south, as a post-nesting season migration. We need more information on this flight of birds and it is to be hoped that increased banding operations will eventually solve the problem.—S. J. CARPENTER, Maxwell, California.

REPORTS.

VIOLATIONS OF FISH AND GAME LAWS.

April 1, 1922, to June 30, 1922.

Offense	Number of arrests	Fines imposed
Game.		
Hunting without a license	3	$95 00
Hunting on posted grounds	1	10 00
Birds—nongame—possession, killing	2	10 00
Birds (shore)—killdeer: possession	1	25 00
Birds—brant—possession	1	----------
Deer—possession, killing, closed season	7	250 00
Spiked buck—killing	1	50 00
Does—possession, killing, closed season	1	50 00
Fawn—possession	1	150 00
Deer meat—possession, closed season	8	200 00
Doves—killing, closed season	1	25 00
Ducks (wild)—killing, shipping, over limit, closed season	2	125 00
Rabbits—killing	2	50 00
Quail—possession, killing, out of season	5	155 00
Hides—illegal possession	1	----------
Taking fur-bearing mammal, closed season	1	----------
Total game violations	38	$1,195 00
Fish.		
Angling without a license	6	$150 00
Blasting fish	1	50 00
Fishing without a license	30	240 00
Fishing in District 2½, closed season	1	25 00
Abalones, undersized, over limit	20	475 00
Barracuda—undersized, possession, selling, illegal	9	475 00
Bass—undersized, possession, over limit, closed season	17	370 00
Clams—undersized, possession, over limit	16	470 00
Crabs—undersized, possession, shipping	9	375 00
Eels (salt water)—undersized, possession	1	20 00
Blue gill—possession, closed season	1	25 00
Lobsters—buying and selling undersized	1	50 00
Perch—possession, closed season	1	20 00
Salmon—selling for profit	1	100 00
Shad—catching with 5-inch gill net	1	----------
Sturgeon—possession	1	20 00
Trout—closed season, over limit	45	805 00
Using Lampara or beach net (seine) in closed district	6	630 00
Using set line in Sequoia Lake	1	50 00
Possession purse net in District 20	5	250 00
Using nets in American District 1	1	250 00
Taking fish within 150 feet of fishway	1	25 00
Taking striped bass with net less than 5½ inches	2	40 00
Taking trout in fish ladder	1	25 00
Discharging offal in Sacramento River	1	25 00
Failing to register fishing boat and gear	2	----------
Total fish violations	181	$4,985 00
Grand total fish and game violations	219	$6,180 00

SEIZURES.

Game.

Ducks	7	Rabbits	1
Quail	2	Deer	1
Spike buck	8 lbs.	Deer meat (jerkey)	150 lbs.

Fish.

Abalones	120	Salmon	25 lbs.
Bass	27	Salmon	1
Bass	1,035½ lbs.	Shad	56 lbs.
Barracuda	5,375 lbs.	Shad	12
Clams	1,012	Sturgeon	1 box
Crabs	44 sacks	Lobsters	19 lbs.
Crabs	8,423	Lobsters	33
Eels (salt water)	20	Trout	31 lbs.
Oysters	74 lbs.	Trout	261
Perch (salt water)	5 lbs.	Venison (salted)	20 lbs.
Perch (salt water)	33		

Illegal nets	5
Searches	2

STATEMENT OF EXPENDITURES

For the Period January 1, 1922, to March 31, 1922, of the Seventy-third Fiscal Year.

Function	Materials and supplies	Salaries and wages	Service and expense	Property and equipment	Total
Administration:					
Commissioners			$89 98		$89 98
Executive offices	$96 11	$4,014 99	1,201 18	$116 75	5,429 03
Printing			921 65		921 65
Research and publicity	26 06	1,050 00	238 05	26 75	1,340 86
Department totals	$122 17	$5,061 99	$2,450 86	$143 50	$7,781 52
Commercial fish culture and conservation:					
Superintendence	$21 01	$2,406 77	$1,073 66	$23 45	$3,524 89
Inspection and patrol	635 58	4,965 00	1,303 15	12 24	6,945 97
Research	175 19	4,546 38	442 63	1,970 43	7,134 63
State laboratory construction	49 70	185 63	3 35		238 68
Statistics	326 10	2,555 15	24 98		2,254 03
Market fishing license commissions			89 50		89 50
Salmon propagation and distribution	732 97	2,838 33	178 16	30 06	3,779 52
Department totals	$1,318 35	$17,497 26	$3,115 43	$2,036 18	$23,967 22
Sporting fish culture and conservation:					
Superintendence	$57 00	$2,850 00	$4,810 26		$7,717 26
General patrol (40 per cent)	212 58	12,394 34	7,143 00	8 95	19,758 87
Trout propagation and distribution	3,008 03	12,337 00	1,495 18	53 23	16,893 44
Department totals	$3,277 61	$27,581 34	$13,448 44	$57 18	$44,364 57
Game conservation:					
General patrol (60 per cent)	$318 92	$18,881 53	$20,588 28	$5 93	$39,794 66
Tahoe camping ground			2 70		2 70
Grand totals	$5,037 05	$69,025 12	$39,605 71	$2,242 79	$115,910 67

CALIFORNIA FRESH FISHERY PRODUCTS FOR MONTHS OF APRIL, MAY AND JUNE, 1922.

Compiled by Fish and Game Commission, Department of Commercial Fisheries.

Species of fish	Del Norte, Humboldt	Mendocino, Sonoma, Lake	Marin	Solano, Yolo	Glenn, Tehama, Colusa	Sacramento, San Joaquin	Contra Costa, Alameda	San Francisco, San Mateo	Santa Cruz	Monterey	San Luis Obispo, Santa Barbara, Ventura	Los Angeles	Orange	San Diego, Imperial	Total	Mexican, brought into California
Albacore												406,366	1,852	29,694	437,912	
Anchovies								48,000		73,200		9,903		500	131,603	
Barracuda											490	1,880,048	8,915	486,442	2,375,895	19,342
Bluefish									83	4,017					4,100	
Boccaccio			4					19,809	26,957	171,888					218,658	
Bonito												4,128		6,337	10,465	1,675
Carp		95		2,485		234	9,331	9,478							21,623	
Catfish		14,728				592									15,320	
Chilipepper								16,400	4,272						20 672	
Cultus Cod	4,317	5,205	42					68,412	17,401	12,726	15				108,118	
Dolphin																
Eels																
Flounders	2,732			2,127			2,996	134,221	34,694	86	88	397		44	177,385	400
Grayfish							250	2,600						79,130	81,980	
Greenfish																
Hake								5,772	16,250						22,022	
Halibut	18,336	2,488	889					12,535	3,076	2,820	108,728	578,749	48,983	167,152	943,756	126,565
Hardhead						13									13	
Herring																
Kingfish							25	613	48,258	135,398	35	41,804	106	1,030	227,269	65
Mackerel									22	86,323	39	570,027	7,664	71,448	735,523	165
Marlin																
Mullet														5,011	5,011	
Perch	22,712		8,644				10	5,240	6,477	8,895	195	10,858	148		63,179	
Pike				13		557	135	365							1,070	
Pompano									26	369		5,603		109	6,107	
S											55	53,317	4,026	43,653	101,051	
	7,679	1,259						99,084	18,302	57,690	4,029	240,577	5,141	137,235	570.996	305
								44,908	38,276						83,184	
	168,457	828,961	3,412	113,859	23,043	160,097	212,550	392,844	381,680	477,219					2,762,122	
								237,078	112,494	1,813		5,835	95		357,315	
								25,675		79,315	60	2,099,375	1,360	528 856	2,734,641	
												10,365		1,218	11,583	
												8,591	110	12,761	21,462	90
			13							69	7,039	821,444	14,948	140,655	984,168	21,049
								11				627	54	3,270	3,962	
				124		595	102	30,298							31,119	
				38,809		70,920	184,848	161							294,738	
				121,604		30,599	489,333								641,536	

Sheepshead												42		643	685	
Shiners								23,265	3,375			2,472	138		29,250	
Skipjack																
Smelt	12,066	157	4,732				1,427	24,164	8,646	23,239	36,405	72,265	220	3,106	186,427	123
Sole	36							994,220	456,134	24,562	6,977	36,252	1,532	1,336	1,521,049	
Splittail							189								189	
Striped Bass			632	28,486		55,907	80,229	92,432							257,686	
Stingaree																
Suckers																
Surf Fish																
Swordfish												80		300	380	
Tomcod								5,117							5,117	
Trout—Farm																
Trout—Steelhead																
Tuna												43,913			43,913	
Tuna—Bluefin												166,816		226,872	393,688	18,600
Tuna—Yellowfin																214,620
Turbot			774												774	
Whitebait	8,401		132					37,348							45,881	
Whitefish											390	11,731			12,121	
Yellowtail												299,096	57	136,613	435,766	3,866
Miscellaneous			9				53	10,135	5,454	36	8,446	18,546	383		43,065	
Total fish	244,736	852,893	19,283	307,507	23,043	319,514	981,478	2,340,188	1,181,877	1,159,665	172,991	7,399,227	95,732	2,083,415	17,181,549	406,866
Crustaceans:																
Crabs (doz.)	2,771		41					7505	24						10,341	
Crawfish (doz.)																
Shrimps			8,800					384,878							393,678	
Spiny Lobsters																46,363
Mollusks:																
Abalones										439,700	9,657				449,357	30,775
Clams—Cockle	298	574	13,138												14,010	
Clams—Mixed	2,535		3,153				1,965	190				42			7,885	
Clams—Pismo									180		50,295				50,475	
Clams—Softshell	195	1,906	20,570				45,871	21,644							90,186	
Cuttlefish	83		28					3,718	6,140	20,479	37	5,551			36,036	
Limpets																
Mussels							1,123	2,218	35	2,640			9,500		15,516	
Oysters—Eastern (No.)			552,653												552,653	
Oysters—Native																
Snails																
Squid										81,466		9,830		50,159	141,455	
Miscellaneous:																
Frogs (doz.)																
Terrapins (doz.)				10			20								30	
Turtles																5,255

All amounts shown in pounds unless otherwise specified. Albacore and Skipjack cleaned

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1921 ABSTRACT SPORTING FISH AND GAME LAWS 1923

OPEN SEASON INCLUDES BOTH DATES GIVEN

SPECIES	DISTRICT	OPEN SEASON	BAG LIMITS, POSSESSION LIMITS, ETC.
DEER	1-1½-4½ 23-24-25-26	Sept. 1-Oct. 15	Two Bucks per season. No Does, Fawns, or Spike Bucks. No sale of venison or skins.
	2-2½-3	Aug. 1-Sept. 14	
	4	Sept. 16-Oct. 15	
RABBITS (Cottontail and Bush)	ALL	Nov. 1-Jan. 15	15 per day. 30 per week.
TREE SQUIRRELS	ALL	Sept. 1-Dec. 31	12 per season.
ELK, ANTELOPE, MOUNTAIN SHEEP	ALL	No Open Season	Killing Elk a felony.
SEA OTTER, BEAVER	ALL	No Open Season	$1,000 fine for Sea Otter.
BEAR, FUR ANIMALS	ALL	Oct. 15-Feb. 28	
DUCKS, GEESE, JACKSNIPE, MUD HENS	ALL	Oct. 1-Jan. 15	25 per day, except Geese. 8 Geese Weekly Limit. See law.
RAIL, WOODDUCK, PIGEONS, SHORE BIRDS	ALL	No Open Season	
QUAIL (Valley, Desert, Mountain)	ALL Except 1½	Nov. 1-Jan. 15	Valley, Desert, 15 per day. 30 per week. Mountain, 10 per day. 20 per week.
	1½	Oct. 15-Dec. 15	
SAGE HEN	ALL Except 4½	Aug. 1-Sept. 15	4 per day. 8 per week.
	4½	No Open Season	
DOVE	ALL	Sept. 1-Oct. 31	15 per day. 30 per week.
GROUSE	ALL	Sept. 15-Oct. 14	4 per day. 8 per week.
TROUT (Except Golden), WHITE FISH	1-1½-2-3-4-4½ Lake Almanor	May 1-Oct. 31	See Game Law Abstract.
	2½	July 1-Feb. 14	
	23-24-25	May 30-Oct.31	
	Lakes, Etc.*	Aug. 1-Oct. 31	
	1½ Winter	Nov. 1-Dec. 31	
	2-3-10 Tidewater	Dec. 15-Feb. 28	
	2-2½-10 Spear	April 1-Jan. 31	
GOLDEN TROUT	ALL	June 30-Oct. 1	20 per day. None under 5 in.
BLACK BASS	ALL, Except 4a, Clear Lake	May 1-Nov. 30	25 per day. None under 7 in. No sale.
	4a, Clear Lake	No Closed Season	
SACRAMENTO PERCH, SUNFISH, CRAPPIE	ALL	May 1-Nov. 30	25 per day.
STRIPED BASS, SHAD	ALL	No Closed Season	See Game Abstract.
SALMON	ALL Except 15	No Closed Season	See Game Abstract.
	15	April 1-Aug. 31	
CATFISH	ALL	Aug. 15-May 14	Closed for commercial fishing.
CRABS	ALL	Nov. 15-July 30	See Game Abstract.
ABALONES	ALL	Mar.16-Jan. 14	See Game Abstract.
PISMO CLAMS	17	Sept. 1-April 30	See Game Abstract.
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*Special provisions see Game Abstract.

HUNTING LICENSES

License Year from July 1 to June 30

Residents, $1.00. Non-residents, $10.00. Certain Aliens, $10.00. Other Aliens, $25.00.

ANGLING LICENSES

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CALIFORNIA FISH AND GAME

"ONSERVATION OF WILD LIFE THROUGH EDUCATION"

Volume 7 Sacramento, October, 1921 Number 4

SARDINE NUMBER

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Volume 8 Sacramento, April, 1922 Number 2

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CALIFORNIA STATE PRINTING OFFICE
SACRAMENTO, 1923

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SEA OTTER, BEAVER	ALL	No Open Season	$1,000 fine for Sea Otter.
BEAR, FUR ANIMALS	ALL	Oct. 15-Feb. 28	
DUCKS, GEESE, JACKSNIPE, MUD HENS	ALL	Oct. 1-Jan. 15	25 per day, except Geese. 8 Geese Weekly Limit. See law.
RAIL, WOODDUCK, PIGEONS, SHORE BIRDS	ALL	No Open Season	
QUAIL (Valley, Desert, Mountain)	ALL Except 1½	Nov. 1-Jan. 15	Valley, Desert, 15 per day. 30 per week. Mountain, 10 per day. 20 per week.
	1½	Oct. 15-Dec. 15	
SAGE HEN	ALL Except 4½	Aug. 1-Sept. 15	4 per day. 8 per week.
	4½	No Open Season	
DOVE	ALL	Sept. 1-Oct. 31	15 per day. 30 per week.
GROUSE	ALL	Sept. 15-Oct. 14	4 per day. 8 per week.
TROUT (Except Golden), WHITE FISH	1-1½-2-3-4-4½ Lake Almanor	May 1-Oct. 31	See Game Law Abstract.
	2½	July 1-Feb. 14	
	23-24-25	May 30-Oct. 31	
	Lakes, Etc.*	Aug. 1-Oct. 31	
	1½ Winter	Nov. 1-Dec. 31	
	2-3-10 Tidewater	Dec. 15-Feb. 28	
	2-2½-10 Spear	April 1-Jan. 31	
GOLDEN TROUT	ALL	June 30-Oct. 1	20 per day. None under 5 in.
BLACK BASS	ALL, Except 4e, Clear Lake	May 1-Nov. 30	25 per day. None under 7 in. No sale.
	4e, Clear Lake	No Closed Season	
SACRAMENTO PERCH, SUNFISH, CRAPPIE	ALL	May 1-Nov. 30	25 per day.
STRIPED BASS, SHAD	ALL	No Closed Season	See Game Abstract.
SALMON	ALL Except 15	No Closed Season	See Game Abstract.
	15	April 1-Aug. 31	
CATFISH	ALL	Aug. 15-May 14	Closed for commercial fishing.
CRABS	ALL	Nov. 15-July 30	See Game Abstract.
ABALONES	ALL	Mar. 16-Jan. 14	See Game Abstract.
PISMO CLAMS	17	Sept. 1-April 30	See Game Abstract.
SPINY LOBSTER	ALL	Oct. 15-Feb. 28	See Game Abstract.

*Special provision see Game Abstract.

HUNTING LICENSES

License Year from July 1 to June 30

Residents, $1.00. Non-residents, $10.00. Certain Aliens, $10.00. Other Aliens, $25.00.

ANGLING LICENSES

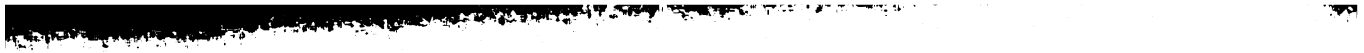
License Year from January 1 to December 31

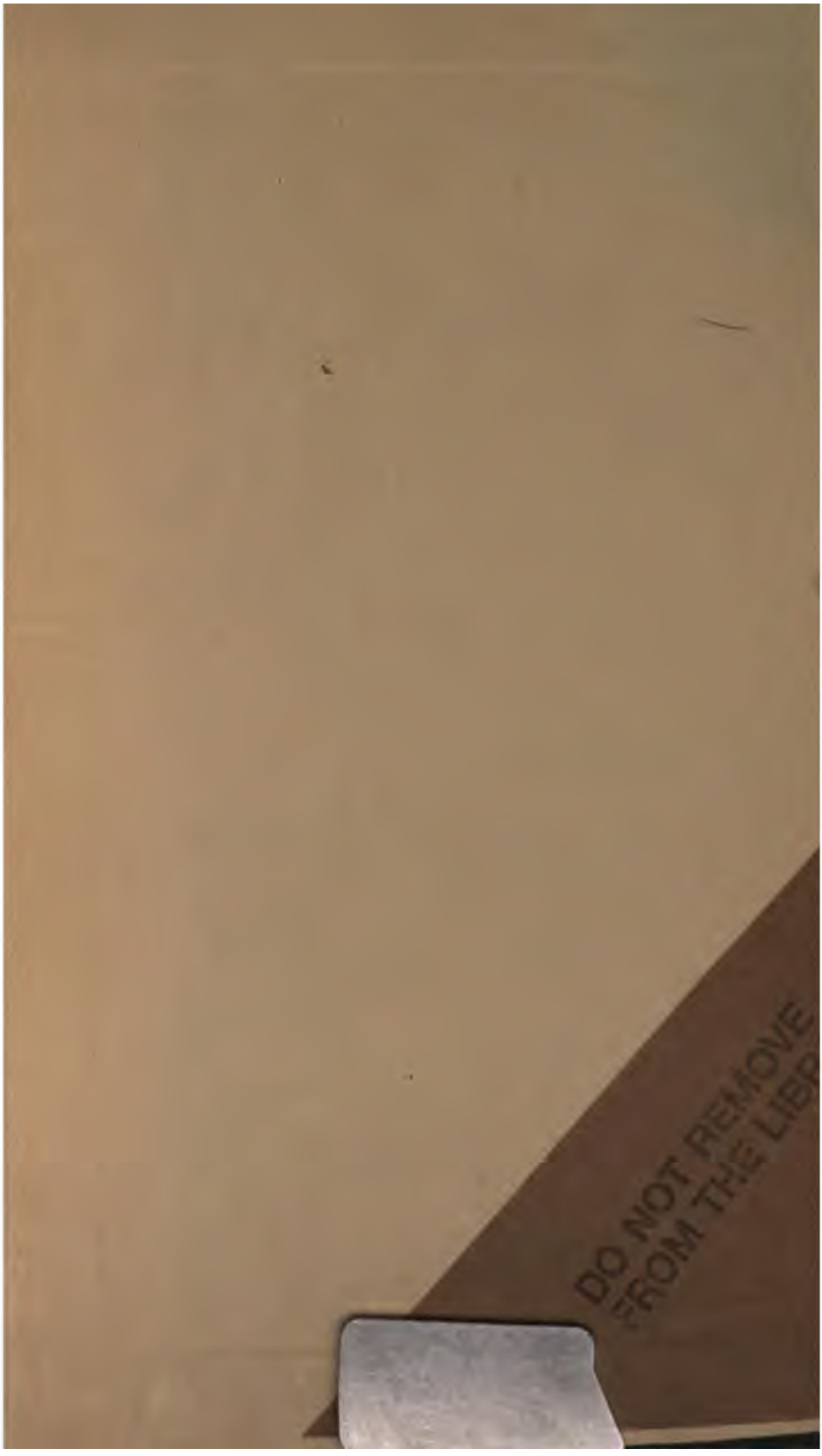
Residents, $1.00. Non-Residents, $3.00. Aliens, $3.00.

TRAPPING LICENSES

License Year from July 1 to June 30

Citizens, $1.00. Aliens, $2.00.

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